

GEOLOGICAL SURVEY OF CANADA

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SECTION OF MINES AND MINERAL STATISTICS.

REPORT
ON THE
IRON ORE DEPOSITS
ALONG THE
KINGSTON AND PEMBROKE RAILWAY
IN
EASTERN ONTARIO

BY
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GEOLOGICAL SURVEY OF CANADA,
OTTAWA.

ROBERT BELL, M.D., D.Sc., LL.D., F.R.S.,
Deputy Head and Director.

SIR:—Herewith I beg to hand you my report on the iron ore deposits of that portion of eastern Ontario tributary to Kingston, covering part of the counties of Frontenac, Lanark, Renfrew and Leeds. It comprises the detailed results of field-work done in 1895 and 1900, supplementing a previous condensed report on the subject. In this work I was assisted by Mr. A. M. Campbell, in 1895, and Mr. T. Denis, B.A., Sc., in 1900.

The general map accompanying the report, is the work of Mr. James White, F.R.G.S., during previous years, when he was attached to the staff of the Mines Section. It was originally undertaken with a view to illustrating the location of the many scattered deposits of phosphate, mica, etc., in that district, and is now issued as an adjunct to this report to provide a means of showing the location of those deposits examined in the course of our work, and also of others gathered from reliable outside sources.

Thanks are due for assistance received, to the officials of the Kingston and Pembroke Railway Company, also to Senator McLaren, Messrs. Joseph Bawden, Wm. Caldwell, J. G. Campbell, R. J. Drummond, W. C. Caldwell, T. B. Caldwell, M. Grady, S. Jackson, T. W. Schwendeman, J. Donnelly, A. J. Macdonell, and many others.

I am, sir,
Your obedient servant,

ELFRIC DREW INGALL

MINES SECTION,
24th June, 1901.

PART I.—INTRODUCTION.

In view of the proposed inauguration of iron smelting at Kingston, Ontario, in 1895, an investigation was undertaken in that year in order to ascertain the capabilities of the district tributary to the Kingston and Pembroke railway, for the supply of ore. The field-work occupied about eleven weeks, and a summarized report of the results was issued shortly afterwards in the Annual Summary Report of the Director of the Geological Survey. This included all information having an immediate and practical bearing on the ore supply question, but the working out in detail of the data collected and the preparation of the same for publication was delayed, owing to the intervention of other work. During the summer of 1900, this investigation was further prosecuted in the field so as to bring our information up to date. The more prominent mines were further examined and more complete magnetic surveys were made with the dial compass as well as the dip needle. This necessarily resulted in the acquirement of much more information, and a better understanding of the problems involved. The substance of the 1896 report is here reproduced, forming as it does, a fitting introduction to the details given in the second part of the present report.

Scope and
character of
the investiga-
tions made.

The main points upon which information was asked by the Kingston people in 1895, and which were covered by the report issued in 1896, already referred to, were as follows:—

The quantity of available ore from immediately accessible localities?

The quality of the same?

The first question, for its solution requires a correct understanding of the nature of the deposits of the district, and therefore of their reliability as to continuity in length, depth, and thickness. This is particularly the case owing to there being no mines then working (1896) from which to judge of the behaviour of the deposits in depth. At a number of places extensive openings have been made but work had been discontinued throughout the district for several years, and the excavations being filled with water, nothing but the surface features remained available for the study of the question.*

* The results of the studies of the mines working during 1900 are given later in the report.

It is thus evident that, using the term "ore in sight" in its proper sense, at none of the places visited were the conditions such as to allow of measurements being made of the cubic contents, and therefore of the tonnage of any considerable block of ore, unless one assumed or imagined, at least one of the three dimensions necessary to be ascertained. At some places there was found a stock pile of ore selected from the material mined; but, apart from that, the question of available ore becomes one of judging in a general way, the possibilities of the supply from deposits already discovered and worked, and of the probability of discovering yet other deposits throughout the district in the future.

Places visited. In order to form an opinion on these points, visits were made to as many as possible of the reported deposits of iron-ore, to the number of over forty, where, besides examining all openings, measuring all ore exposures and collecting illustrative specimens, both of ore and rocks, surface and magnetic surveys, were made in many places. The points visited, including many reported hematite occurrences, were as follows:—The Bluff Point and Calabogie mines of The Calabogie Mining Co.; the Coe mine; the Martel or Wilson; the Culhane; the Williams or Black Bay; and the Jerond mines, all in Bagot township, and within a radius of three miles of Calabogie station on the Kingston and Pembroke railway; the Radenhurst and Caldwell properties in Lavant township and near Flower station, and in the same township the Wilbur mine; the Robertson and Mary mines near Mississippi station in Palmerston township, all situated near the line of the Kingston and Pembroke railway north of Sharbot lake. Between this point and Kingston, the mines of the Glendower group were visited, namely, the Bedford or Glendower mine; the Howse mine and the Black Lake mine.

Of the district tributary to Kingston, by way of the Rideau canal, time only permitted visits to the two chief places, viz., the Chaffey and Yankee mines, near Newboro'.

In the north-western corner of Lanark county, the mines visited were the old Foley mine openings with those adjacent to it, and several reported hematite occurrence in Bathurst township. In Dalhousie township, visits were made to the old Playfair hematite mine and to a number of reported indications of the same mineral in that vicinity, as well as to one on the eastern shore of Dalhousie lake.

In the township of South Sherbrooke, the mines visited were the Christie's Lake; the Bygrove; the Fournier (with the adjacent Allan mine in North Crosby); the Silver Lake and others near Christie's

lake, whilst near Maberly on the Canadian Pacific railway in the northern part of the township, examination was made of the range of properties, taken up for iron, extending from near the station westward to the property of Mr. Rudd, in Oso township. Although some-what distant from the present railway communications, a trip was made to the Yuill mine near the western end of White lake in Darling township. The above, together with reported hematite occurrences in Storrington township on Dog lake, which connects with the waters of the Rideau canal, on Birch lake in Bedford township, and some other points of lesser importance, constitute the localities it was found possible to visit as examples in the time at disposal.

A glance at the accompanying general map of the district dealt with, shows many of its leading features.

General features of the district.

It covers an area of about 1,600 square miles, and along its length of about seventy miles, it is traversed by the Kingston and Pembroke railway, which is connected by short spur lines, with the more important mines. Crossing it and connecting with the above, are the Bay of Quinte railway system, and the main line of the Canadian Pacific railway between Montreal and Toronto. The Brockville, Westport and Sault Ste. Marie railway, would also connect with Kingston, either by means of the waters of the Rideau canal at Newboro', or by the all rail route through Brockville. Furthermore the navigable waters of the Rideau canal and all its ramifications through the series of connecting lakes, shown on the map, give water connection to many points in the district. Transport of ores from these points and of material to them can thus be effected by scows and small tugs. Steamers of moderate draft ply regularly on the main channel of the canal during the summer months.

Transportation facilities.

In the case of deposits now situated, or subsequently discovered, on or near the shores of any of the other large lakes, transport by scows towed by small tugs, would often save wagon haulage of many miles. It will be seen also that the district is well supplied with roads. These, of course, are of varying degrees of excellence, the main routes being kept in good condition. In winter, the cost of transport is greatly reduced by the use of sleighs, as steep hills can be avoided and short cuts made by passing over the frozen swamps and lakes of the valley bottoms. The district is thus seen to be well provided in the matter of transport.

The very numerous lakes, creeks and rivers ensure a bountiful supply of good water, and also provide at many places, water-powers of vary-

Water supply. ing importance. Falls of 100 feet or over, on large streams, occur at several points. Many of these water courses have been used for years for bringing lumber from distant points and this enlarges the possibilities of the timber supply of the district.

Timber. The pine limits of this district have been worked vigorously in former years, and owing to this, and to extensive bush fires in places, they have seen their best days, still so much of the country is yet bush-covered, that for general purposes, small timber could be obtained locally in most cases. This would especially be true in regard to spruce, tamarac, etc., and the cedar of the numerous swamps found in the valley-bottoms.

Surface features. The sections underlain by the paleozoic sedimentary rocks of the southern portions, coloured pink on the map, are fairly even and level and provide large tracts of good agricultural land. They are consequently largely cleared and settled. The Archaean country to the north, containing the mineral deposits, is more rugged, and, in places, is very hilly, the erratic courses of the roads evidencing the difficulties arising from this cause. In these sections numerous hills occur, often with steep sides and bluff faces, but without any very marked regularity or arrangement in definite ranges. They vary from one to several hundred feet in height, above the general level of the country, but none attain to the dignity of mountains, although often so designated locally.

There is a general rise all along the Kingston and Pembroke railway in going north until the summit is reached near Wilbur mines, at 907 feet above sea-level, from whence there is an average falling away in the direction of the Ottawa river valley further north. The highest hills in the district covered by the map attain to a little over 1,000 feet above sea-level or to about 754 feet above Lake Ontario at Kingston.

Settlement and farming. The proportion of bare rocky uplands, is necessarily large, although the soil where it does exist in hollows, swampy lowlands and valley flats, is fertile. The farms and agricultural settlements, are numerous, although less extensive and more scattered than those further south, mixed farming being followed in the lower levels, while sheep-raising is successful on the higher and more rocky portions. Mining operations will therefore never encounter any difficulty or enhanced cost on account of either food or labour supply. Wages would be about at the rates paid elsewhere in eastern Ontario.

Wood fuel for mining purposes is obtained from the surrounding bush lands, which at most points ensure a plentiful supply. In the case of extensive and long continued operations, this would of course have to be drawn from continually longer distances, and in the end it might be necessary to import coal from the eastern United States.

It must be remembered that the area dealt with in this report is only that immediately tributary to Kingston, which could supplement its ore-supply by rail from other iron ore districts of eastern Ontario and adjacent portions of western Quebec, as for instance from the deposits near Ottawa, as well as from still more distant points both in Canada and the United States along the course of the navigable waters of the great lakes.

Geologically the district presents a series of gneisses, schists and various igneous rocks with associated limestone belts and areas. On the denuded surface of this series, which is classed as Laurentian, have been deposited the various sediments constituting the lowest beds of the Palaeozoic series. The latter is encountered in passing southward, forming a continuous sheet, covering the older rocks. Northerly from the edge of the fossiliferous rocks, however, outliers of the same of varying thickness and extent are scattered widely over the country. In the basal sandstones and conglomerate beds of this fossiliferous series occur the hematite ores, whilst the deposits of magnetite, apatite, mica, etc., occur in the Archean.

General
geological
features.

The Laurentian forms a complex made up of igneous rocks of gneissic and granitic structure and very variable mineral composition. These are accompanied by belts and areas of crystalline limestone. The general strike of the whole is north-easterly throughout the district and the dip south-easterly, sometimes at quite steep angles and sometimes lying comparatively flat. North of Calabogie at the Black Bay and Culhane mines, near Norway lake, the dip seems to be northerly, but the data obtained during the examinations made were not extensive enough to enable a judgment to be formed as to whether this was merely local or otherwise.*

The limestones are crystalline in structure, and frequently are quite marble-like in texture. They trend N.E. along with the general strike of the formation and show very varying widths of outcrop, which, whilst in part produced by changes in dip, is also due to irregularities in thickness. As in the case of the limestone areas found in the apatite region

Limestones.

* For the broader features of the geology of this section, see the forthcoming report of Dr. R. W. Ellis, of the Geological Survey Department.

of Ottawa county, they carry inclusions of the associated rocks in greater or less profusion and amongst their contained minerals are decomposition products of the same. These inclusions help to mark the banding of the limestones, especially where brought into relief by weathering action. Quartzose streaks, bands and nodules, are amongst the commonest features of this kind. In some places over large areas, there is quite a distinct colour banding in gray and white, which, when accompanied by the marble-like texture, before mentioned, gives a value as an ornamental stone, for monumental and building purposes.

Excepting with regard to those sheets of water along the north-facing escarpment of the palaeozoic rocks, these limestone belts and areas seem to have been a determining factor in the formation of the lakes, watercourses and valleys whose parallelism to each other, and to the trend of the formation, will be evident from an inspection of the map. Bays, points and chains of islands in the lakes are found to exhibit the same connection with the harder and softer belts. Although these rocks may, for the most part be rightly termed limestone, they possibly contain enough carbonate of magnesia in places to rank as dolomites. The data available are, however, insufficient to enable any conclusion to be arrived at in regard to chemical composition over any large district.

Gneisses,
granites, etc.

Apart from the limestones, the great bulk of the formation is made up of material of such mineral composition as to affiliate it with the igneous class of rocks. The microscopic investigations as yet made into their nature is limited to too few determinations, to permit very definite conclusions. Those given in the appendix at the end of this report supplement the results of the field observations but they only justify general and tentative statements in regard to the matter.

Areas exist, often of considerable extent, of acidic rocks of coarsely granitic structure which may represent intrusive masses in the formation. Such a one was noted some little distance south from Calabogie along the Darling road. Many of the coarser grained basic rocks, probably gabbros, etc., of confusedly crystalline structure and without any sign of parallel arrangement of their mineral constituents, as at the Chaffey & Matthews mines, may also represent eruptive masses. A definite opinion as to the relationships of these more basic rocks to the rest of the series, could not be arrived at without much more extended field study, so that nothing further can be said as to whether they are merely basic members of the series or intrusive masses in it.

Apart from these, however, the great bulk [of the formation would consist of rocks, varying in chemical composition from quite basic to more acidic members, and in structure from distinctly schistose to more thickly banded gneisses. The structure of the gneissic rocks is, as elsewhere in the Laurentian, of varying degrees from slightly marked parallelism, in the granitic gneiss, to the varieties with distinct bands of contrasting mineral composition marked often by quite acidic and distinctly basic alternations. Thus, thin sections of hand specimens are apt to reveal under the microscope simply local phases, and the realization of the grand aggregate of the mineralogical features of the whole formation yet awaits extensive and systematic petrographical research.

Character of gneisses, etc.

A study of the data given in appendix A will give some useful ideas however as to their petrographical affinities, more especially of the members immediately associated with the magnetite ore-bodies.

It will be noted that we have representative amphibolite as at Bluff point and the Campbell mine at Calabogie, diorite at the Martel, Culhane, Christies Lake, Robertsville and Ritchie mines and altered amphibolite at the Bedford mines. Examples of gabbro-diorite are given from the Fournier, Bedford and Ritchie mines. Amongst the examples of the more acidic rocks are biotite-granite gneiss from Wilbur and augite-syenite gneiss and syenite from the Ritchie mine.

The basic rocks, amphibolites, gabbros, and diorites, are amongst the more intimate associates of the magnetite bodies. Among the associated minerals, the most interesting are apatite, pyrite, ilmenite and sphene, all having an evident economic interest, and, as bearing on the formation of the ore-bodies, we note the constant presence of alteration and decomposition products such as scapolite from plagioclase and hornblende, chlorite, etc., from augite, whilst calcite resulting from rock-decomposition is of constant occurrence.

Although no faultings of the formation were particularly noted or traced out, many such probably exist and affect the continuity of the rocks and chains of ore-bodies. An instance of these possible effects, has been noted in the case of the Wilbur mine of which a description is given later.

For particulars of work done in earlier years in this district by the Geological Survey, see:—The Geology of Canada, 1863, and the Reports of Progress for 1870-71, 1871-72, 1872-73, and 1874-75, wherein will be found the results of investigations made by former officers of the staff, together with descriptions of some of the ore-deposits. Most of the more important and largely worked deposits were not, however, discovered until after the publication of the above mentioned reports, and the descriptions given herewith are therefore the first ones which have been made.

Although the ores mined in this district so far have been almost altogether magnetites, in the past, the Dalhousie or Playfair mine shipped hematite for several years, and at many points in the district similar ore is reported as occurring, although it has nowhere else been developed to any extent.

Magnetite
deposits.

Magnetite.—Regarding the district in general and its probable future ore producing capacity, a correct judgment could not be formed if the fact were ignored that the deposits are irregular in their nature. It would seem as if, so far, this feature had hardly been recognized sufficiently, and thus we find most observers in the past assuming that the ore occurs in beds, and therefrom erroneously inferring the continuity of the ore-bodies between widely separated outcrops, and in some cases forming most exaggerated estimates of the amount of ore which could be regarded as proved to exist.

Use of
magnetic
needle.

Then also in using the dip-needle, this same error would appear to have been frequent. If, for instance, on a given run of rock or direction across country, a few high dip-readings were obtained in a distance of several miles, it would be assumed as proved that a continuous bed of ore exists, only requiring sinking on it to open it up for extraction.

In travelling through the country opportunity was taken to point out, that by so using the dip-needle, comparatively little can be proved when, as in most cases, the observations have not been taken sufficiently close together to justify definite conclusions. Also, that all such conclusions must be modified and interpreted in the light of knowledge acquired by a study of the worked deposits and of their nature and peculiarities. For example, it was found that many of the worked deposits consisted of isolated masses of magnetite in compact, dark, basic (dioritic?) rocks, and many of the dip-readings were obtained along the strike of similar basic members of the series, where no outcrops of ore showed, leaving it to be concluded, in the absence of anything to the contrary, that these isolated dip-readings might be taken as showing the existence of separated masses of magnetite of greater or less extent rather than of a continuous bed of ore.

Other
indications.

Another feature which has led to misapprehension in many cases has been the prevalence of outcroppings of rusty rock which have generally been taken as indicating the existence of iron ore. As a matter of fact, the colour of these rusty parts seems to be almost always due to the decomposition of pyrites plentifully disseminated through the rock.

Whilst, however, all these points must be taken into account in judging individual deposits, the wide-spread occurrence of ore bodies throughout the district as a whole, and the great likelihood of further discoveries, leading to a large addition to the list of deposits already known, would seem to assure its future as an ore-producer capable of supplying any smelter of reasonable size that might be erected; just as in the case of the phosphate mining district of the Rivière du Lièvre in the province of Quebec, where, whilst the deposits of that mineral show similar irregularity, the output of the district was considerable and steady for over seventeen years, and ceased only because of low prices, and in no way because of any failure with regard to its capabilities for yielding the mineral.

The mode of occurrence of the magnetite deposits may be briefly summarized as follows :—

Character of
magnetite
deposits.

The chief deposits which have been worked may be classified under three heads, viz.:—First, ore-bodies occurring at the actual contacts of belts of crystalline limestone with the harder gneissic and schistose members of the series. Second, ore bodies where the magnetite occurs in ribs, or impregnating schistose or gneissic belts, in most of which cases limestone is either absent from the vicinity altogether or only occurs at some little distance from the ore-body. Third, ore-bodies occurring entirely within areas of basic rocks, very much after the manner of the apatite deposits of Ottawa county, province of Quebec, where these are found in the pyroxenites. In the first and second classes there is a tendency for the ore-bodies to follow along the strike of the formation, either entirely isolated from each other or separated by intervening stretches of rock, either free from magnetite or too poor to pay for extraction. This tendency to follow the strike has been recognized by the local prospectors, and it will be evident by studying the map of the district and the plans of the mines accompanying the report. Where the ore occurs in the schistose rocks, the magnetite frequently shows itself as detached grains, plentifully disseminated through the substance of the schist, varying in proportion between the extremes of magnetite-bearing schist and ore with a small intermixture of bisilicate minerals.

The limited microscopic studies already made, seem to point to the probability that magnetite is, in any case, one of the constituents of the basic members of the formation as a whole, and many of the ore-bodies of economic importance may probably be the final results of processes of secondary concentration. Field studies certainly leave this impression, especially in view of the alteration effects noted in the immediate

vicinity of the ore bodies. Of such are the very frequent existence of chloritic envelopes and selvages, probably representing the local alteration of the bisilicate minerals of the surrounding rocks—the more largely crystallized mica and other minerals occurring under these conditions—the replacement of the plagioclase by scapolite—the alteration of pyroxene to hornblende, marked in approaching ore ribs—the presence of calcite in the rock and in patches, etc., apparently of secondary origin—the further breaking down of basic rocks into serpentinous masses in the vicinity of the magnetite, and the intermixture and interbanding of similar products through the ore itself.

In the third class mentioned above, the ore shows itself in detached irregular occurrences, the rocks being at some points reticulated by numerous veins, seams, etc., of magnetite, showing at times vuggy or drusy cavities, with crystals of calcite, hornblende and other minerals. The magnetite will thus vary very considerably in its occurrence, from places where there is a large admixture of foreign matter to those where the ore is in considerable mass, and comparatively pure. These features are possibly due to magmatic differentiation.

Size of
ore-bodies

The developments made in the district in the way of proving the deposits, have been comparatively shallow in most instances, being limited to depths under 100 feet; although in a few cases, by means of pits and diamond drill holes the ore has been proved to a depth of 300 feet. Longitudinally, the distance between the extremes of any range of pits would come well within 2,000 feet for the most extensive mine in the district, while in most instances the known extent in length of any string of ore-bodies is covered by a few hundred feet, and frequently the whole development consists of one more or less circular pit.

As to the thickness of the ore-deposits, it is extremely variable even in the more regular belt like masses. At the same mine, it is found to vary from one or two feet up to 30 or 40 feet; whilst with regard to the more irregular deposits in the basic rocks, it would be impossible to actually say which dimension of the pit should be taken as the width. At Robertville the extreme dimensions of the large pit were 200 feet in depth, 100 feet in length, and 55 feet across the thickness of the deposit. At the old Chaffey mine, there are three large pits, separated only by narrow walls of rock. They are said to be about 50 feet deep, and would measure, in the case of the two larger, 50 by 150 feet, and for the smaller, about 30 feet by about 150. At the Yuill mine there is a pit about 130 feet in length, reported to be 60 feet

deep. These examples will illustrate the dimensions of some of the largest of the irregular ore-bodies of the district. It is stated that the Robertaville mine shipped over 60,000 tons, which further indicates the size attained by such ore-bodies, and as it is stated that the three diamond drill holes put down on the hanging wall side went through twenty feet of ore, at a depth of about 350 feet, the body of ore evidently extends a considerable distance below the depth at which the work was abandoned.

In some cases nearly the whole of the material taken out has been shipping ore, as evidenced by the small mass of the waste pile compared to the size of the excavation, although in most instances the amount of waste has been considerable. In one case where a close approximation could be arrived at from the data available, the proportions were roughly one third waste to two thirds shipping ore. It might possibly run as high as half and half at some places.

The magnetite ore of this district presents the following features. The shipping ore of course represents the best, as selected from the general run of the ore mined, and is in general pretty free from sulphur as far as visible pyrites is concerned. The various piles of ore examined, with very few exceptions, showed no visible apatite. Beyond this, no further statement can be made as to the percentage of sulphur and phosphorus which might be expected in the ores of the district taken as a whole, and in large shipments, short of spending considerable time and money in really sampling large piles. That the percentage of these deleterious ingredients does not prevent the use of the ores in the blast furnace under proper conditions, is evidenced by the fact, that as long as the prices permitted their exportation, the United States smelters were quite willing to buy and use them.

Character of
magnetite
ores.

The ore-bodies do carry pyrite and often in considerable quantity, but in most cases in such a way that the pyritous parts can be rejected by hand picking. At some points visited, however, the pyrite was so finely and evenly distributed throughout the ore as to render its elimination by this simple process impossible, and this has also been found to be the case in portions of some of the larger and better known deposits which have elsewhere yielded large quantities of clean shipping ore. In the case especially of some of the isolated occurrences in the basic rocks, apatite occurs associated with magnetite, mention being made of such later in the report.

As shown by the ore piles, the foreign matter which would have to be dealt with in smelting would be mostly of a fusible nature, consist-

ing of hornblende, micaceous and chloritic material distributed through the mass, as well as in the seams in the ore. Calcite is also a common ingredient, with more rarely quartz. These minerals, by proper selection, should make a good slagging mixture.

In grain, the ores at different points show varying characters. Those of the ore bodies in the basic areas are apt to show a peculiarly vitreous fracture, vuggy structure, and interferent crystalline aggregation of the magnetite; whilst at other points the structure of the ore is schistose, platy or granular, with a coarse or finely crystalline cross fracture.

The examination made of the ore-piles of the district showed a visible admixture of foreign materials, already mentioned, of from five to fifteen per cent, estimated by the eye. This would of course bring down the theoretical percentage of iron in the magnetite (72.37 per cent) to from 60 to 65 per cent.

Chemical
constitution
of ores.

A table has been prepared of all the available analyses of the iron ores of this district and is given at the end of the report (Appendix B.) With a few exceptions it represents analyses made at various times in the laboratory of the Geological Survey and published in the reports, and includes the analyses of the series of specimens collected during the field examinations undertaken for the purposes of the present report. With one exception, these analyses are all of hand specimens and can therefore only be taken as giving a general idea of the composition of the ores. However the following statement based upon the existing information may be given:—

Of the 65 determinations of metallic iron, 49 were of magnetites and 16 of hematites, the average of the former being 57.03 per cent, of the latter 55.25 per cent. If, however, we eliminate those specimens which gave over 15 per cent insoluble matter as not representative of shipping ore, the average percentages become 59.53 for hematite, and 59.08 for magnetites, the latter agreeing closely with the analysis of the average sample from Bluff Point mine, marked in the table with reference letter—A.

Of the 37 determinations of phosphorus in the magnetites, that element varied from a trace to 0.17 per cent, the latter amount occurring in the average sample—reference letter A. In one specimen, although this element was not determined, small crystals of apatite were visible to the eye. The average was 0.022 per cent. In eleven hematites this element averaged 0.077 per cent, owing to a few specimens which ran exceptionally high, notwithstanding that 7 of them ran below 0.05 per cent. The extreme range lay between 0.004 and 0.3

per cent. It is curious and interesting to note that the magnetites, Chemical Constitution of Ores, occurring as they do in rocks so frequently containing apatite as a microscopic constituent, and in a formation throughout which so many economic deposits of that mineral have been worked, average lower in phosphorus and show less variation in that respect than the hematites whose conditions of occurrence would hardly lead one to expect such a feature.

Ten of the analyses of magnetites give returns of sulphur contents ranging from a trace to 1.75 per cent and showing an average of 0.58 per cent. This is considerably higher than that of the analysis of the average sample—reference letter A. which shows 0.17 only. In four hematites, the sulphur returned ranges from 0.004 per cent to 0.7 per cent and averages 0.037 per cent. Titanic acid was looked for in two hematites, but it was not found. In the 25 examinations of magnetites, this element was proved to be absent in thirteen cases: present but not determined quantitatively, in two others, and in the ten other cases present, in percentages varying between 1.03 and 16.45. The extreme variability of this constituent is evident on reference to the tabulated analyses. For instance, in the specimens from the Chaffey and Yankee mines, whilst one showed but a trace, others ran as high as 12 and 16 per cent. There seems to be a generally higher average, as might be expected, in ore occurring as these do in a coarse very basic rock (probably an intrusive gabbro).

Thus it may be stated that in so far as these analyses represent the general character of the ores, the percentage of phosphorus averages low, the sulphur is in some cases rather high, while the titanium, with a few exceptions, is inconsiderable in amount. Should it be found advantageous in some cases to do so, the amount of sulphur might no doubt be reduced by roasting and by careful selection. It is unfortunate that neither the time nor means at disposal permitted of the gathering of samples representing large quantities of selected shipping ore, so that the one analysis of an average sample (reference letter A) is all we have of this nature. In order to arrive at a reliable conclusion as to the quality of ore the district is capable of providing, and in view of the variable nature of the deposits, such sampling would also have to extend over long periods of time without which it is not possible accurately to determine what proportion of phosphorus, sulphur or titanium would actually have to be dealt with in furnace charges or to what extent it might be advantageous to mix these with other ores. The ores of the district have been used already by managers of smelters in the United States, presumably in this way and lately,

also, the Canada Iron Furnace Company, in the province of Quebec has used these ores for admixture with their own bog ores. The constant improvements in methods of smelting in late years have of course rendered it possible to utilize more impure ores than formerly and even in making the best kinds of steel a much lower grade of pig can be used.

**Shipments of
Ore.**

It is stated that in the past the total shipments from this district have amounted to some 250,000 tons of magnetite, to which must be added about 30,000 tons from the Dalhousie and McNab hematite deposits.

**Hematite
Deposits.**

Hematite.—A number of points were examined where deposits of hematite were reported to occur, with a view to ascertaining the possibilities of obtaining supplies of this class of ore. Apart, however, from the old Dalhousie or Playfair mine in Dalhousie township, nothing was seen that could be properly described as a hematite deposit. In some cases the only indications consisted of pieces of hematite, either lean or rich, ploughed up in fields; at others, an ochreous impregnation of the rocks or soil had led to the belief that the prevalence of so much rusty material must indicate the existence of solid hematite in depth. In every case, however, a little investigation of the surroundings would demonstrate the connection of the phenomena with the occurrence of outlying patches of the *basal beds of the sedimentary series. Where this formation showed distinctly, it would appear as if the supposed hematite deposits consisted of shattered portions of the sandstone, the spaces between the broken pieces being filled up with loose ochreous oxide of iron, which had also percolated into and filled the interstices between the grains of the sandstone, thus giving the whole a very rusty appearance. In places, specimens could be obtained of the solid hematite; but these, judging from all appearances, probably owe their condition to a further consolidation of the original loose ochreous form of the oxide. This action, however, has only gone on to a limited extent, nor did it seem likely at any of the particular points visited that any large quantity of the richer and more solid material would be obtained. The bulk of the material, wherever seen, consisted of sandstone impregnated or stained with ochreous oxide of iron to a greater or less extent, constituting at best a very lean ore.

It was found impossible, in the time at disposal, to visit all the reported occurrences of hematite, but in most cases, from the descrip-

* The age attributed to the outlying patches of these rocks, viz. Potsdam or Calceiferous, is probably correct in most instances, although at places distant from the present edge of the Paleozoic and at higher elevations, they may represent shore deposits higher up in the series, their position being due to overlap.

tions given, it is evident that they are similar to those noted. In the report of the Royal Commission on Mineral Resources of Ontario, pages 128 to 142, many such places are mentioned, and at one place viz., Tamworth, a number of shallow pits had been put down, which proved the superficial nature of the deposit, and that it was underlain by crystalline limestone. The quality of the ore here is said to have varied also from rich to quite lean.

Character of
Hematite
Deposits.

The Geological Survey called attention, years ago, to similar occurrences in the Potadam* at other places, as will be seen by referring to the Geology of Canada, pages 87 and 89, and the dolomitic nature of this formation in places was also alluded to.

Taking everything into account, it may be assumed that the phenomena observed are the result of the decomposition of ferruginous dolomitic parts of the sedimentary rock, with the formation of ochreous oxides of iron, and further consolidation of the same in spots into the hematitic form. It is also possible that these cases resulted from percolation downwards from the overlying rocks, and joint-planes and cavities.

In a few cases the ore is found apparently passing down into the underlying Archæan rock, but evidently to a limited depth only, and in such a way as to lead to the belief that these cases resulted from percolation downwards from the overlying rocks, and joint-planes and cavities.

Of those visited, the Dalhousie mine is the only one having any features of a continuous ore-body. The interesting point about this mine, lies in its being a body of ore extending downwards for a known depth of 100 feet into the crystalline limestone. It is suggested, however, that it simply represents continuous material leached out from the originally-overlying sandstone, deposited in a waterworn cavern in the underlying limestone. This view is borne out by several features observed on the spot, and shown in the plan and sections of the mine already alluded to: the regular shape of the ore-body; the fact of its continuing underground without cropping, being in fact entirely overarched by limestone; the smooth limiting surface between the ore and the limestone; the tendency of the body to show a general lense-shape, and to thin out gradually in depth. This thinning out in depth is also mentioned as a feature of the Arnprior deposit in McNab township, which occurs similarly in crystalline limestone.

Dalhousie and
McNabmines.

From the published description of this place, it would seem to be very similar to the Dalhousie mine. It is said to have been worked

to a depth of about 80 feet, when, according to one account, it thinned out, and according to another it was cut off by a fault.

Bog Ores.

Bog Ores.—No deposits of bog iron ores were visited, but the existence of these is reported at a number of places in the district.

General Conclusions.

Summary.—Reviewing the results obtained by the investigation and having in view the answering of the questions propounded, the conclusions arrived at may be stated as follows:—

There seems no reason to doubt the possibilities of the district in the matter of supplying ore for a smelter of the size contemplated (viz., 100 tons per day) providing exploratory and developmental work is kept well ahead of the actual work of the extraction of the ore, for although the ore-deposits are irregular in their nature, yet the occurrences already known are numerous, and doubtless many others would be located by explorers, were a demand to arise for the ore.

Apart, however, from the general chances as above set forth, the question of ore immediately available must remain in abeyance, as naturally no measurement of 'ore in sight' could be made with most of the mines abandoned and full of water. The ore supply would be almost entirely magnetite, with possibly some hematite or bog ore. In the magnetite, careful selection would probably be necessary in the case of some of the deposits in order to keep the proportion of sulphur low.

PART II.—MAGNETITE DEPOSITS.

Parts II. and III. following give the detailed descriptions of the various iron-ore deposits examined in the field during 1895 and 1900 and supplements the foregoing general report on the district given as Part I. which appeared in substance in 1896 as before stated.

GLENDOWER MINE.

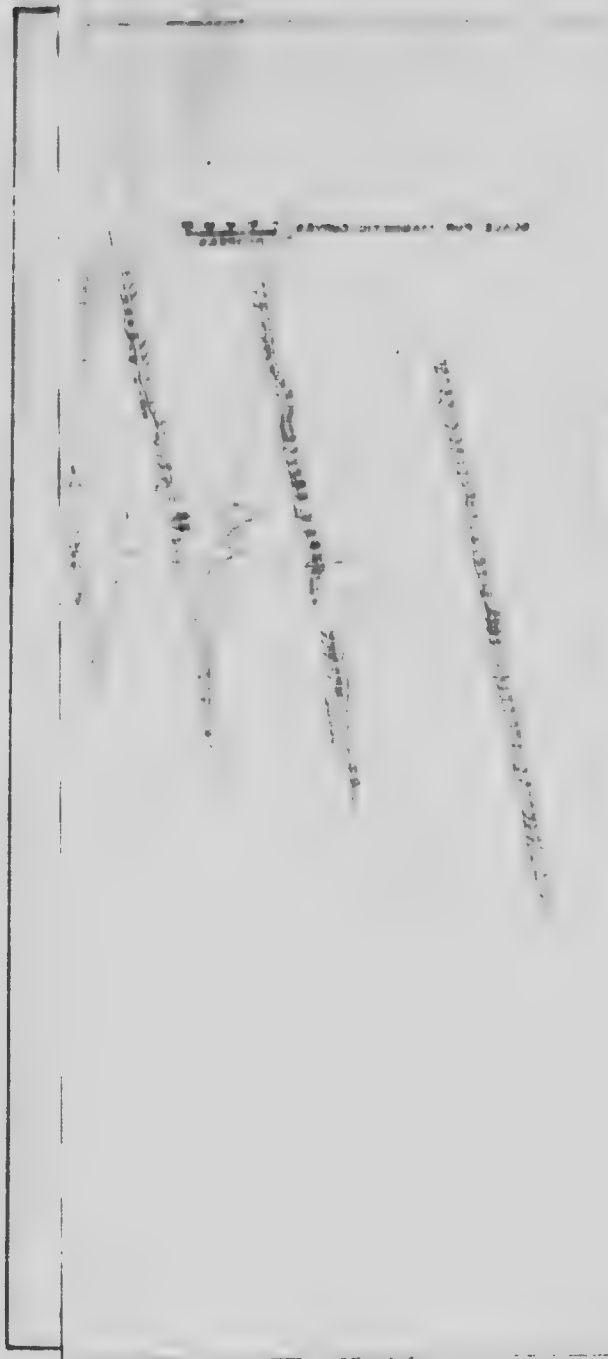
Bedford Township, Con. II., Lot 6 and Con. III., Lot 6.

Glendower Mine.

This mine is situated within four miles of Bedford station, on the Kingston and Pembroke railway, with which point it is connected by a branch line. The main workings are on Con. II., lot 6, and Con. III., lot 6, near to the west shore of Thirty Island lake.

The ore-bodies developed in the workings are in gneissic rocks immediately at or near their contact with a belt of crystalline limestone.

THE UNIVERSITY OF CHICAGO



EXPLANATORY NOTE.

Readings of the dip-needle plotted as curves.

Deflections of the horizontal needle shown thus:


 meaning 50° N.E. — 30° N.W. — 90° S.E. — 10° S.W.





EXPLANATORY NOTE

Readings of the dip circles plotted as curves
Deflection of the horizontal needle shown that
magnetic 20. N.E. 20. N.W. 20. E. 20. W.

**BEDFORD OR
GLENDOWER MINE.**
BEDFORD TOWNSHIP, FRONTENAC COUNTY.

- ONT. -

SCALE 400 FT. = ONE INCH.



Surveyed by E.D. Ingham A.R.S.M. 1900.
Magnetic Readings by Theo. Denis B.A.Sc.



G N E I S S I

LOT No. 6

KINGSTON & PEMBROKE RAILWAY

Approximate Northern Limit

L I M E S T O N E

LOT No. 5

Approximate

GNEISSIC ROCKS

Southern
THIRTY



The
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The latter rock outcrops extensively to the south of the main workings, occupying all the interval between them and the arm of the lake, which runs parallel with the line of the pits, and about 600 feet south of them, in a westerly direction, for about three-quarters of a mile. Immediately to the north of the workings the gneissic rocks of the series are largely developed. These as a whole represent the varied character usual in this formation ranging from pale-coloured acidic and intermediate rocks to very dark heavy basic members. An area of the latter occurs north of the eastern workings. It is roughly triangular in shape being about 500 feet wide at its eastern end and tapering to nothing at a point about 500 feet west of No. 5 pit. No sharp delimitation is evident on the ground between this area and the gneisses of more normal composition to the north, of which it probably represents a localized basic phase.

This area while generally basic in character, and apparently largely composed of hornblende coarsely crystallized frequently presents a largely mottled appearance from the existence of concentrations and veins of black coarsely crystallized hornblende traversing a lighter coloured base consisting of hornblende crystals with a waxy looking mineral of feldspathic appearance. The latter portion of the rock is more easily decomposable than the darker parts. In the hornblendic veins vugs occur at times which are lined with well formed crystals of the same mineral. In places this basic area presents fine-grained compact dark-brown rocks very rotten and decomposed.*

Pyrite seems to be very plentiful at places and its decomposition evidently causes the general rustiness of the rock exposures. Calcite particles and efflorescent sulphate of iron are also common occurrences. The northern contact of the limestone with the gneiss is very distinctly traceable along the south side of pits Nos. 1, 2, 3, 4 and 5, as shown in the accompanying plan.

The actual contact is not visible west of this point, but from the way the rocks outcrop from beneath the cover, it must run in a direction approximately W.S.W. passing north of pit 6. The limestone crops out with frequency, forming a ridge between the last mentioned point and pit No. 8 on the adjacent lot to the south, where the basic rocks show again. It has thus an apparent breadth of outcrop of some 800 feet, which would represent a thickness of about 650 feet taking the actual width of the outcrop shown of pit 8, as above, and the dip at that point to be about 55 degrees. The southern limit of the belt as

* For particulars of the microscopic characters of these rocks see Appendix A, specimens Nos. 11, 12, 13 and 14.

Glendower
Mine.

marked on the plan is worked out on the basis of the above thickness taking into account the various dips.

Commencing at the easternmost, or main pit, close to the shores of the lake the details observed were as follows:—

Pit No. 1.—This working consists of an open cut run in a westerly direction into the hill, in the gneissic rocks at their contact with the limestone. At its lower or eastern end it is opened out to a width of about 30 feet and gradually narrows to about a yard wide at its western end, where it ends as a shallow trench along the contact.

At the wide mouth of the open-cut, the main shaft has been sunk, which, at the time of closing the mine previous to our visit, is said to have attained a depth of about 180 feet. It is said that this shaft has been considerably chambered out and that some drifting and cross-cutting was done at the lower level. The outcrop of the ore-body on which this working has been made seems to have thinned out in passing west. A number of small test pits had been made between this and working No. 2, but no ore was observed in them.

Working No. 2.—This is but a short distance to the west of the west end of the last. It is a large open pit opened into by an open-cut running south-west into the hill the whole working being excavated in the gneissic foot-wall rocks, the limestone hanging wall forming its southern side. It is opened out about 70 feet along the strike of the deposit, and is about 40 feet wide and perhaps 30 to 35 feet deep from the top of the hill. In the south-west corner of the pit is to be seen the mouth of an incline evidently sunk on the dip, and close to the contact. The depth of this is however unknown.

The walls of the open pit show a coarse hornblendic rock, much stained with rust evidently arising from the decomposition of the pyrite visibly present. The ore seemed to be represented by several stringers of magnetite a few inches thick, so that whatever body there was at this point must have been taken out and the work stopped in comparatively barren ground.

Workings No. 3 and 4.—At these points nothing particular was noted. The former is a shallow, open prospect trench, and at the latter is a shallow surface pit, from the bottom of which has been sunk a small shaft said to be 100 feet deep. They are both in the brown, rather rotten, gneissic rock, the limestone contact showing on the south side of No. 4.

Working No. 5.—Is a long open pit close to the track. It is mostly filled with debris. The rock is dark-brown, earthy and decomposed,

showing in places magnetite in grains. Some small ribs of that mineral are occasionally to be seen penetrating the rock. At one point in the pit a little solid ore outcrops through the debris, showing for a foot or two in length and about the same thickness. Between this pit, however, and No. 2, a number of little prospect pits in these same rotten, brown earthy and rusty rocks seem to indicate an attempt to find workable ore between the two points. In picking all around I obtained occasional bits of good ore, and often the rock on fresh fracture, was seen to carry disseminated grains of magnetite.*

Working No. 6.—Consists of an open cut 15 feet in depth, of irregular shape in the side of a hill of limestone. A pit sunk at the eastern end is said to be quite deep. Good ore is reported as having been encountered in the bottom. An examination of the walls of the excavation shows irregular, flat-lying tongues of ore, associated with decomposed rocky matter, apparently originally similar to some such basic rocks as are associated with the ore in the eastern pits. Where worked out in the main workings, the ore is said to have a thickness of from 20 to 40 feet.

Working No. 7.—Is a little test shaft down about 25 feet showing no features which could be noted without making the descent, for which, there were no means available.

Pit No. 9.—At this point occurs a very interesting ore-body consisting of magnetite and apatite in about equal proportions in a gangue of calcite. It occurs in the more acidic gneissic rocks some little distance north of the run of the other ore-bodies and as described, its mode of occurrence is quite different. The pit is about 25 feet deep, and the ore-body which was small was altogether worked out. The test pits shown did not expose any more ore, but proved only the extension for some distance eastward of the calcite vein in which it occurred. This was mined to meet a demand for phosphatic ore for the Hamilton smelter.

* Since the above was written some further work has been done at the points numbered 5 and 5a on the plan, and ore has been extracted and shipped. The excavations are altogether in the same dark-coloured rock which at places was found to contain coarsely crystallized aggregates of hornblende crystals. It evidently represents a decomposed portion of the surrounding basic area. A small rib of limestone from a few inches to a foot or two in thickness occurs at this place, having the usual strike and appearing in working 5a and in the S.W. corner of working 5.

Working No. 5 consists at present of an open-cut alongside the track, about 150 feet long, averaging 40 feet wide and about 10 feet deep to the surface of the water. At the western end is a little pit about 15 feet deep. At No. 5a is an open cut into the north face of the ridge, with a shallow pit in the S.W. corner.

Glendower
Mine.

Diamond Drill Borings.—Subsequent to the closing down of the mine previous to our visit, a series of diamond drill holes were bored from the hanging wall side which it is stated proved the existence of considerable ore below the old workings. These are marked A., B., C., C¹, C², and D. on the accompanying plan, and on the vertical section given there.

The four right hand columns in the following tabulation of particulars regarding these drill holes have been compiled from the description of the work given in the *Journal of the Canadian Mining Institute*, vol. 1., part 1., pp. 205-6. The reference letters coincide with those adopted in the accompanying plan of the mine, the holes having been simply described in their order in the publication quoted.

Particulars of bore—holes made with the Diamond Drill at the
Glendower Iron Mine.

Designation of hole on Plan.	Direction.	Angle.	Depth.	Rocks, etc., Encountered.	Remarks.
			feet.		
A.	N.	80	182.5	Crystalline limestone; hornblende; granite and quartz successively pierced. Ended in large drift from old shaft.	The rock formations pierced were limestone and granite with bands of hornblende and quartz. Holes C., C ¹ , and C ² all drilled with the machine on the same site.
B.	S.	75	702	Boring being almost parallel to ore-body the latter was not encountered.	
C.	N.	70	197 to 280	Through ore formation for 83 feet.	
C ¹ .	N.	78	270 to 445	Through 175 feet of ore formation.	
C ² .	N. 10° W.	78	205 to 450	Ore formation cut across.	
D.	N.	85	0 to 425 425 525	Chiefly limestone. Ore body first encountered. Hole finished on quartz.	

From the data given in the publication referred to and by reference to the plotting of the same on the plan of the mine, several interesting features are brought out. *Hole A.* simply gave a measurement by which the average dip of the hanging wall of the deposit at that place can be ascertained. This would seem to be at an angle of about 76°, although the dip of the wall taken at surface measured 80°. *Hole C.* is said to

have passed through 83 feet of ore formation. Taking the average dip at that point from the surface down (78°) this would represent a thickness across the formation of about 45 feet. The outcrop of actual ore, however, does not show this width at surface, so that the deposit lacking definite limitations, it is difficult to arrive at a close estimate of the actual thickness represented by the ore ground penetrated. The fact remains, however, that irregular as the shape of the ore body may be, both this hole and the next cross it at an acute angle so that the thickness will be much less than could appear to be shown by the cores. *Hole C.* being at a steeper angle necessarily cuts the ore body so as to pass through a much greater distance in traversing its width. Even allowing for this, however, the 175 feet of ore formation reported shows either an appreciable thickening or that the body dips more steeply below the point at which it is pierced by hole C. *Hole C. 2.* cutting the plane of strike of the ore-body at an angle should show a greater length of ore ground traversed than in the case of the previous hole. The amount reported is, however, less by some twenty feet so that it would look as if there was a thinning out in passing westward. This surmise seems to find some corroboration in the results obtained further west again in hole D. At this point the ore ground traversed is reported at but 100 feet, which taking an average dip of about 80° , would be equivalent to somewhere about 25 feet of thickness. In all such interpretations the great irregularity of these deposits in every respect must however be borne in mind. Lacking definite boundaries, the mere fact that the last few feet of a hole were through barren material, does not by any means justify the assumption that the limit of the deposit has been reached and it seems a pity that the holes bored were not carried for quite a distance into the footwall rocks in order to prove the presence or absence of parallel ribs of ore. The 700 feet bored simply parallel with the formation at point B. might more profitably have given two flatter holes at C. and D. cross cutting the whole.*

Magnetic Readings.—So far as these were carried out the results attained are illustrated by the curves, etc., shown on the plan. The time at disposal did not allow of reading at sufficiently close intervals to enable the minutiae of the distribution of the bodies of magnetite to be worked out, but some general conclusions can be drawn. It will be seen that the area of considerable magnetic disturbance is practically coincident with that of the very basic rocks extending some dis-

* Judging from the data given on a sectional drawing of these holes lately obtained from Mr. Jos. Bawden, of Kingston, the existence of a rib of pure ore 20 to 30 feet thick was proved, the rest being ore ground.

Glendower
Mine.

tance north of the limestone contact between pits Nos. 1 and 5. At the eastern end this area of magnetic disturbance would have a width of about 350 feet narrowing down to about 200 feet along the line of observations crossing No. 5 pit. This does not, of course, represent the actual width of the ore-bearing zone as the needle is necessarily affected by the ore-body for some distance on either side. This will be seen by reference to the curves on the plan where the lines of observation approach the pits from the limestone side. The magnetic results obtained along the lines to the west of No. 5 pit would seem to point to the absence of any chain of ore-bodies between the eastern pit and the workings Nos. 6 and 7. These lines being about 400 feet apart there might of course be some small bodies along the contact in between them.

Ore shipments, etc.—Close to the track where it passes the main shaft at No. 1 working there was at the time the mine was visited a pile of several hundred tons of ore. In this it was noted that pyrite and calcite were considerably in evidence and an eye estimate placed the admixture of foreign material at about 10 per cent. In the evidence regarding this mine given before the Ontario Mineral Commission of 1888, it is stated that the ore shipped from the mine ran from 50 to 60 per cent in iron contents. When it was being worked by the Glendower Company, they, having a long wagon haul to their shipping point, sent away no poorer ore than 60 per cent. It is further stated that the Zanesville Company, having built a branch line, could ship directly from the mine and that the percentage of ore ran as low as 50 per cent iron. From the same source it is learned that the ore first obtained was free from sulphur, but that this constituent in deleterious quantity was encountered at a depth of about 180 feet.

According to Mr. Bawden, of Kingston, who has been connected with mining in the district for years, this mine shipped about 50,000 tons of ore up to 1895.

History of the mine.—The following items relating to the history of the work done at this mine are gathered from the evidence of Mr. J. Bawden, given before the Ontario Mineral Commission, before mentioned.

After some years of development work by the first owners, the Glendower Company was formed in 1873, who not only paid down a sum for the lease of the mine, but also twenty cents per ton royalty. They mined for seven years, at the end of which time they gave up the lease. This Company had a capital of \$50,000, largely subscribed by

furnace owners of Elmira, N.Y., to which place they took the ore and
 professed themselves well pleased with it. Glendower
Mine.

About 1883, in the fall, the Zanesville Company was formed of capitalists of that place and of Cleveland, Ohio. They constructed the branch line to the mine, and operated on a large scale with extensive plant, for four or five years. The capital of this Company was \$200,000. In 1887 this Company was merged in the Kingston and Pembroke Mining Company, which, with a stock capital of \$400,000, took over this, and a number of other mines, in the district.

At the time of our visit in 1895, the mine had been idle some years.*

Bedford Township, Con. II., Lot 5.

At the bottom of the bay which runs in south of, and parallel to, Bedford H.N. the Glendower range of ore-bodies, is a small prospect pit from which some magnetite has been obtained (See working No. 8 on the plan). It is interesting as showing the occurrence of ore near the other contact of the limestone belt along the northern side of which lie the workings previously described under the heading of the Glendower mine. As there mentioned, the limestone out cropping shows a width of about 600 or 700 feet. The little prospect pit is only about four feet deep, in the bottom of which is an exposure of ore, measuring about twenty-five by fifteen feet.

Stripping and trenching has been done about the pit, evidently with the intention of determining the direction of extension of the ore-body. Nothing definite, however, seems to have been proved by the work. In one of the trenches about thirty feet to the north of the pit, some coarsely crystallized hornblende rock is shown.

At the pit the ore seems to be overlaid by a decomposed, dark green rock, with parallel seams of a lighter green material. It has the appearance of dipping slightly southward. The ore shows similar parallel seams of the light-green material, and its resemblance to the inclosing rock in this and other respects leaves the impression that it represents a highly magnetiferous portion of the same.

A little pile of ore has been set aside measuring about ten tons. It carries a considerable proportion of intermixed foreign material,

* At the time of the examination made in 1900, the mine was also idle although it had been leased during the previous year to the Hamilton Smelting Company, of Ontario, who had done some little work around pit No. 2 and had opened up pits Nos. 5 and 5a.

amongst which calcite is observable, and pyrite, the latter fairly frequent.

The magnetic curves given on the plan, of the observations made with the dip needle at this point speak for themselves.

HOWSE MINE.

Bedford Township, Con. I., Lots 3 and 4.

Howse Mine. About a mile and a half to the south-west of the last mentioned, are some pits which are known by the above name. No examination was made of these, but they are of interest as showing the extension of the chain of ore-bodies on the south side of the lime-stone belt. Mr. Jas. White of the Survey staff, when making the surveys for the map accompanying this report, made notes also of the geological features, in some parts of the district. He found the westward extension of the Glendower limestone belt to run to the north of the pits. It is said that considerable ore was shipped from this point.

BLACK LAKE MINE.

Bedford Township Con. IV., Lot. 8.

Black L.
Mine.

About a mile and a half north-east from the main workings of the Glendower mine, on the point of an island in Black lake, a slight amount of work has been done on an occurrence of magnetite. At the place visited was a small open cut running into the side hill having a face of about 10 feet at its deepest point. The dip of the rocks seems to be flat, say from 25 to 30 degrees southward. No foot wall is visible but about 10 feet thickness of rotten schistose ore rock, shows. Much of it exhibits a speckled fracture, from the intermixture of grains of magnetite with some decomposable matter which now appears simply as a pale yellowish earthy material. In some places the magnetite grains preponderate largely, and are even consolidated, thus constituting the solid 'ore.'

All the rocks around are so rusted and rotted, that it would be impossible to make out their exact nature. This appears to be due to the decomposition of pyrite which is very plentifully distributed throughout their mass, on the hanging wall side of the pit. A black, scoriaceous-weathering rock, forms the shore of the lake, which at a few places shows as yet unaltered, largely crystallized, dark hornblende,

similar to some of the rock exposures at the Glendower mine and on lot 5, Con. II., before described. Whether the ore at this point, is near the northern or southern contact of the limestone belt, could not be determined in the time at disposal. Black L. Mine.

Near the opening just described is a little pile of some 50 cub. ft. of lumps of ore. It carries a very large percentage of intermixed matter in which calcite patches are prominent, and what appears to have been a bi-silicate mineral but which is now decomposed, is present in grains. Finely disseminated pyrite is also very plentiful. These were the only workings it was found possible to visit.

It is said that it was leased to a company from 1882 to 1884 who took out from 3,000 to 4,000 tons on a 50 cent royalty.

Mr. Bawden, in his evidence before the Ontario Mineral Commission, says:—"The Black Lake property was under prospecting lease to the Bethlehem Mining Co. and some 50 tons of rich ore have been taken away. At the time it was under lease, there were great difficulties in the way of transportation; since that time, a canal has been cut from Thirty Island lake to Black lake.....and the ore can be brought down to the permanent track at Thirty Island lake.

Bedford Township, Con. III., Lot 3.

Bedford, III.,
3.

Some small test pits and strippings have been made on magnetite bodies on this lot and a diamond drill hole has been sunk to a depth of about 300 feet. A large development of basic Laurentian gneiss occurs in this vicinity, in which are isolated bodies of magnetite of varying size.

An interesting occurrence of apatite of small extent had also been found in the same rocks a little distance from one of these magnetite bodies.

MISSISSIPPI OR ROBERTSVILLE MINE AND MARY MINE.

Robertsville
and Mary
Mines.

Palmerston Township, Con. IX., Lots 3 and 4.

The Robertsville mine is connected with the Kingston and Pembroke railway by a short track of about a mile in length, and when working the ore could be hoisted from the main pit and dumped directly into the cars.

The pits of the Mary mine are close by on the adjacent lot.

Robertsville
and Mary
Mines.

The mode of occurrence of the ore-bodies in this place contrasts with that at many other localities in the district in that there is no limestone in the immediate vicinity nor connected with them.

The rock immediately inclosing the ore is a dark, compact, heavy basic rock, probably diorite which seems to extend for a considerable distance around.* Whilst in the field-examination, no gneissic structure was noticed except in a few places where it seems to be slightly developed, the hand specimens brought back seem on closer examination to have some parallel structure. The rock exposures around the mine show an irregular, pink, felspathic veining, and a light-green mineral probably epidote is frequently seen in patches. On examination of the hand specimens, pyrite seems to be fairly plentiful throughout the rock and in one of the small felspathic veinlets, octahedra of magnetite could be seen; epidote occurring in the same veinlets.

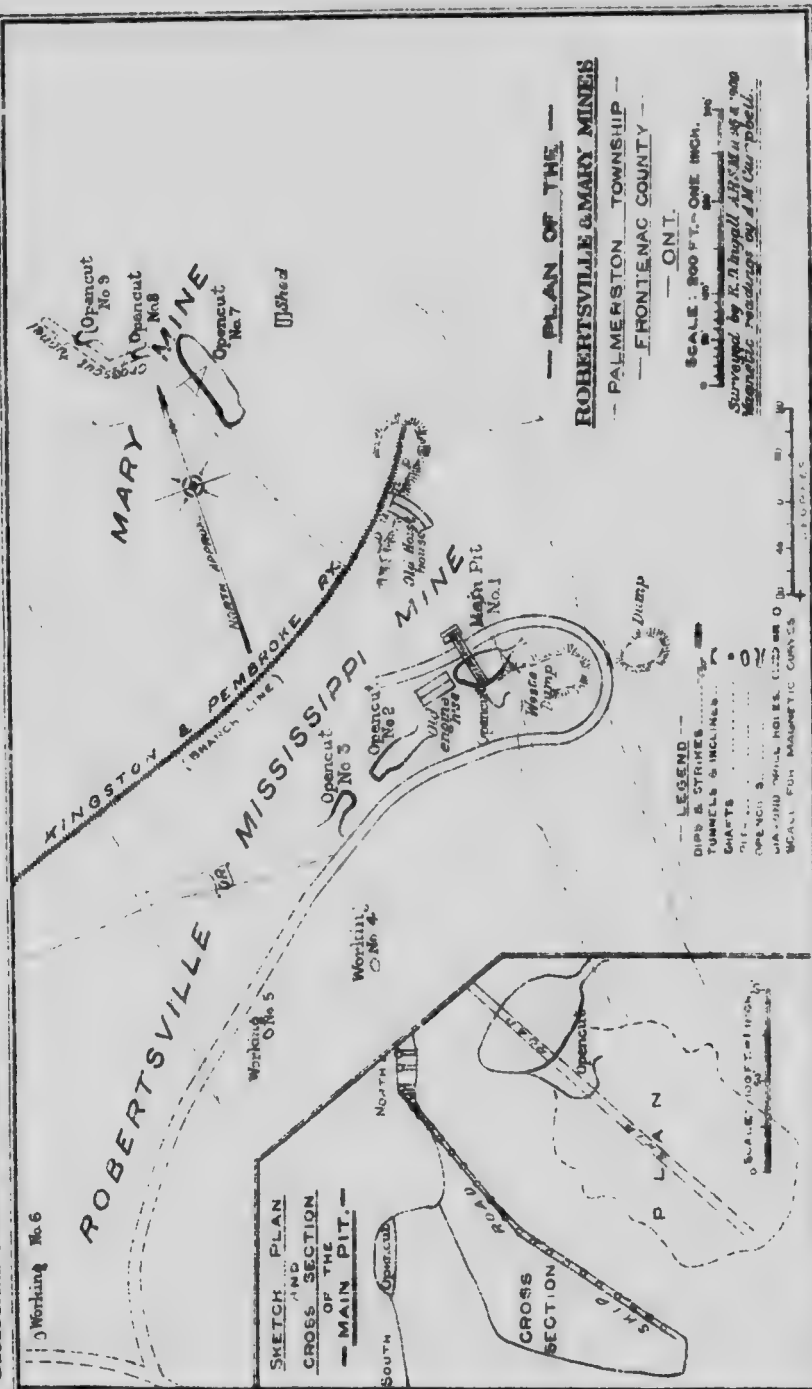
The developments consist of the main pit, a couple of shallow open-cuts near it and two small pits at some little distance from the large working. The accompanying plan shows the relative positions of the various openings and other features.

Working No. 1.—This is the most extensive. It consists of an irregular opening about 200 feet deep with an extreme longitudinal dimension of about 108 feet, the ore having been worked out to a thickness of over 50 feet in places. The excavation is simply a large irregular pit as will be seen by reference to the sketch plan and section given in the accompanying illustration, which also conveys a good idea of the irregular size and shape of many of the ore-bodies worked in this district. The average dip is seen to be about 52° southerly. The existence of ore at a depth of about 140 feet below the bottom of the pit is said to be proved by a diamond drill hole which was put down on the hanging wall side at an angle of 65°. Two other holes about 100 yards south of this pit and about 100 feet apart are said to have attained a depth of over 500 feet, and to have passed through 20 feet of ore.

Working No. 2.—About 100 feet to the west of the main pit is a shallow open-cut about 60 feet by 25 and about 10 to 15 feet deep. It has been opened into a little ridge of rock and is about 20 feet higher than the mouth of the main pit.

At this point there was a good chance to observe the mode of occurrence of the ore which in the notes taken on the spot is described as occurring in the basic country-rock as a veiney, often 'vuggy' mass

* See Nos. 17 and 18 Appendix A.



of irregularly reticulated magnetite, with pink and cream-coloured calcite and black hornblende. The magnetite is plentifully inter-mixed through the rock in extensive irregular patches, and more intimately in veinlets and as scattered grains. Felspar patches are frequent and light-green epidote is a prominent feature. White quartz is also present although less frequent than the other minerals mentioned. The ore is frequently loose-textured from the presence of vuggy seams lined with crystals of hornblende, etc. Although at places the ore occurs in more solid masses with only a little admixture of the other minerals, over the main part of the rock surface exposed in this working, these other minerals together with rock inclusions will include 50 per cent of the mass.

Robertville
and Mary
Mines.

The foregoing description may be taken as applicable in a general sense to the other occurrences of ore at this place, and in other parts of the district with that class of deposits located in areas of compact basic rocks. Of course the different points opened up vary very much in the degree of concentration of the magnetite, that mineral at many places occurring in large concentrated masses yielding large quantities of very pure ore. It is evident, however, that such occurrences will be found in working, to be very variable and irregular. If, however, this feature is recognized and acted upon in dealing with them and prospecting work, both surface and underground, carried on systematically, in many instances it would doubtless be found that the number of ore-bodies would compensate for their irregularity. This constituted the noticeable feature in the phosphate mines of Ottawa county, Quebec, which worked for so many years successfully. In some of their pits the body of apatite would be worked out in a very short time, whilst in others a more or less abundant supply would be had for years.

Open-cut No. 3.—At this point a small open-cut has been driven east into the same ridge as the last mentioned, attaining a depth of 15 feet at its inner end. The rock seems to have a gneissic structure here and dips about 45 degrees south getting steeper as it goes down.

Pit No. 4.—Is a small test shaft, depth unknown. A rib of ore about 5 feet thick shows at the surface.

Pits 5 and 6.—Are just small prospect holes showing nothing in particular.

Open-cut No. 7.—This is in a side hill and is about 15 feet deep with a sinking in one end apparently only a few feet deeper. The ore occurs in dark basic rock similar to that at the other points, and shows the same reticulation of ore and associated minerals.

Robertsville
and Mary
Mines.

Open-cut No. 8.—Here a small open-cut into the side of a hill ends in a little tunnel about 125 feet long which turns in such a way as to pass under the working at No. 9, at a slight depth below the surface.

Open-cut No. 9.—Is a shallow open-cast working from which some ore has been taken, which at the time of the examination was piled near the opening.

Diamond Drill Exploration.—Besides the diamond drill holes described above, a number of others were put down on the hanging wall side of and at some distance from the range of ore-bodies along the strike, but no records are available as to results attained.

Shipments.—It is stated that between 6,000 and 7,000 tons of ore were shipped from this mine up to 1895, and according to the owner of the mine the ore shipped carried no sulphur.

Dip Needle Readings.—Six preliminary lines of dip needle readings at every ten paces were taken, but no particular attraction was shown except in the immediate vicinity of the main pit, and between pits 7 and 8, at the Mary mine openings.

Palmerston,
XI, 27, 28

Palmerston Township, Con. XI., Lots 27, 28.

About a mile along the road west of Lavant station, on the Kingston and Pembroke railway, a little work has been done on an occurrence of magnetite. It consists of a small pit about 10 by 12 feet and, judging from the dump of rock, not very deep. It is at the base of a little limestone ridge, and the ore is at the contact of that rock with a gray gneiss.

The limestone shows at places, a contorted structure which is well brought out by the sinuous course of bands of magnetite of various thickness, and of other included minerals, among which actinolite and chlorite are of frequent occurrence. As noticed elsewhere this latter mineral seems to specially affect the limiting walls of the ore-ribs. The little ore-pile shows good ore, with some attached limestone and a little intermixture of chloritic and hornblendic minerals.

BYGROVE MINE.

Bygrove
Mine.

South Sherbrooke Township, Con. I., Lot 3.

At this place little or no developments have been made. The work done consists of a pit about forty feet long by twenty feet wide. Its

depth, judging from the amount of the material extracted, and from Bygrove mine. information given by the residents of the vicinity, would be about twenty-five feet. It is full of water up to within ten feet of the top.

By careful chipping around the walls standing above the water-level, magnetite could be found in irregular, and apparently not very persistent ribs, varying from an inch or two, to a little over a foot in thickness, but they seemed often to thin out very rapidly in places, and to come in in other places in quite an eccentric manner.

Besides the pit mentioned, blasts have been put into the outcrop of the deposit, at several places, covering a length of about fifty feet. These workings have not been at all extensive, and show magnetite occurring in the same irregular way as in the pit.

As far as could be determined the strike is parallel to that of the distinctly banded gneissic rocks, seen to crop out to the southward, commencing about twenty feet from the pit. The work done is not of such a nature or extent as to enable a clear idea to be formed, as to the direction and extent of the outcrop, but if it continues to the west, it must be hidden by the cover of soil found in that direction, whilst to the east it does not show at all and the country rocks cropping out as they do also to the south, form apparently, a continuous bar to its extension in that direction.

A little to the north and east is a small rusty outcrop surface, like that of the rotten, rusty gneisses, so often found in this formation, which by assuming a turn in the strike, might have been taken to represent the deposit, but this would seem to be a somewhat doubtful assumption, as it evidently carries no magnetite and is all friable, breaking down under the pick. The rustiness here, as elsewhere, is probably due to the decomposition of pyrites contained in the rock.

In fact the continuance for any distance, of this local ore-bearing feature of the formation, seems very problematical, notwithstanding the theory started when the district was first being worked, that this occurrence was a continuation of the Fournier mine deposit, over four miles to the eastward.

Ore characteristics.—The ore taken out has been left in a pile near the pit, and probably represents the whole output, except a small experimental shipment of about six tons, said to have been made. The ore pile to-day would seem by measurement to contain about 140 tons, which agrees closely with the statement made in Mr. Vennor's report on this district (Report of Progress, 1870-72, p. 313). An examination

Bygrove mine. of this pile showed it to consist largely of hornblende largely crystallized, but sometimes more finely with ribs and seams of magnetite through it. It is probable that the intermixed material would amount to fully fifty per cent of the whole. Pyrites is present but not in very large quantities.

Country rocks.—To the south of the pit for some distance there is a considerable development of gneiss of an acidic character. To the northward definite outcrops of solid rock are infrequent, there are, however, no signs of limestone for some distance at this point. The walls of the pit show a rather rotten brownish gneissic rock. The mineral character of the deposit could be best described as magnetite in irregular ribs and veins, or disseminated, associated with coarse, blackish-green hornblende, the latter crystallized in interferent aggregates, showing bright sparkling cleavage fracture surfaces. Occasionally vuggy places occur, lined with hornblende crystals.

FOURNIER MINE.

South Sherbrooke Township, Con. I, Lot 14.

Fournier mine.

The workings known by the above name consist of some five pits and other openings of various dimensions. The ore worked occurs in an area of basic rock which seems to consist largely of hornblende and augite with white feldspar. Biotite is plentiful and pyrite seems to be fairly frequent in the various rock specimens collected. A banded arrangement of the constituents of the rock was noted at places, the bi-silicates alternating with whiter bands consisting of feldspar and quartz. At places the rock would seem to consist of quite coarsely crystallized aggregate of biotite, hornblende, etc., constituting a dark basic rock, whilst lighter coloured acidic areas also occur, apparently consisting largely of feldspar and quartz. The contact of these with the darker basic portions is not clear cut but is rather mergent. The ore occurs as irregular ribs and veins, and masses of a compact magnetite with a vitreous fracture. Where these occur in the basic portions of the rock, it frequently happens that the walls of the rib or vein are lined by large crystals of biotite, the crystallization of the basic rock also getting coarser and more hornblendic as it approaches the magnetite rib.*

From the accompanying plan it will be noticed that the pits and croppings seem to follow three parallel ranges having a general direc-

* See Appendix A, Specimens Nos. 8, 9 and 10.

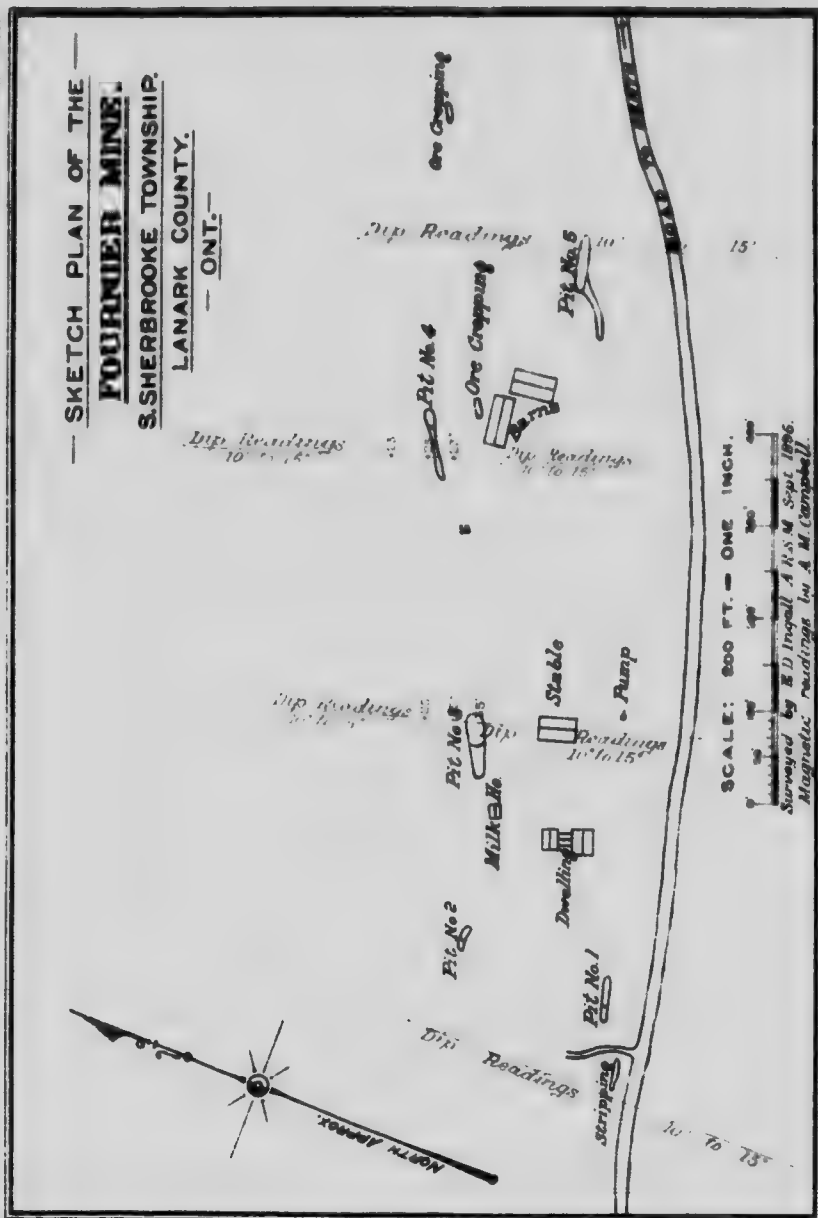
— SKETCH PLAN OF THE —

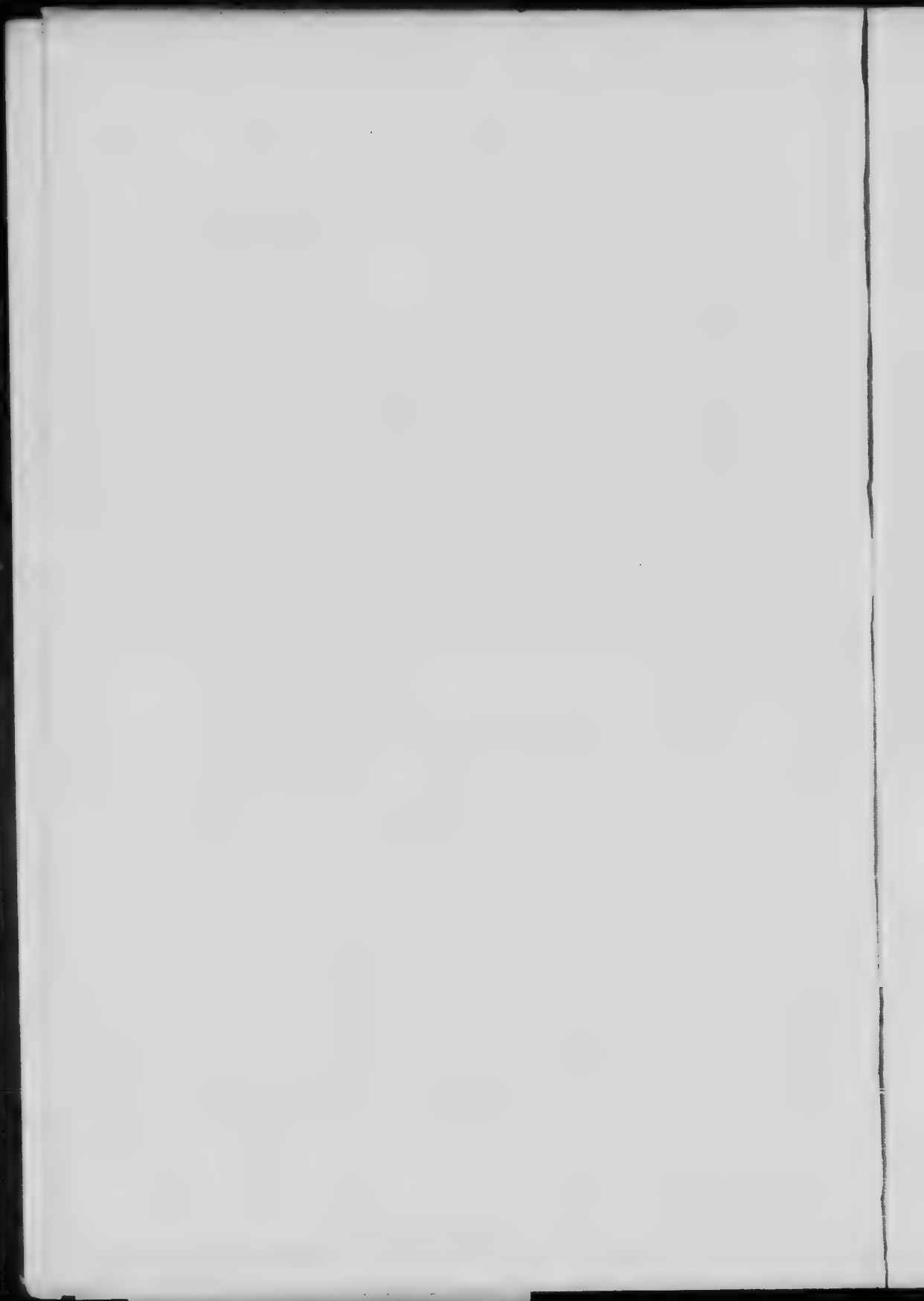
FOURNIER MINE.

S. SHERBROOKE TOWNSHIP.

LANARK COUNTY.

— ONT. —





tion of about E.N.E. and W.S.W. This direction of the run of ore occurrences coincides roughly with that of the general formation of the district as shown on Mr. Vennor's map.*

Pits Nos. 1 and 5 are on the most southerly range, pits Nos. 2, 3 and 4, on the most northerly, and the small ore croppings behind the barn, together with a similar one about 300 feet about E.N.E. seem to constitute an intermediate zone.

Whilst this is true, however, regarding the arrangement of the workings, etc., neither observation of the ground nor the result of the dip-needle readings so far as made favour the idea of the continuity of the ore between the different pits on the same range. The particulars of the different pits as far as could be observed on the surface are as follows:—

Working No. 1.—Is a shallow pit in the rock. A little ore was found in place at the west end, but it was so grown up with rushes that but little further could be seen. The small stripping to the west of this point consists of a shallow cut made by a few blasts on the outcropping of a small rib of magnetite, a few inches thick.

Working No. 2.—An irregular pit about 15 feet deep in the heavy basic rock. It is, however, so grown up with brush that but little can be seen. In the rock stripping at the west end of the pit a small isolated patch of ore occurs, exhibiting a surrounding envelope of dark hornblende mineral. The hornblende of the rock shows at places, dark and coarsely crystallized.

Working No. 3.—Is a large open cut about 70 feet long by 20 feet wide with a deep pit at one end. According to our guide, this is about 120 feet deep and the ore-body was stated from his recollection to have been about 2 feet thick. Mr. Vennor's description of this mine in the Survey Report 1874-5 says:—

"During the summer of 1873, the last attempt at raising the ore for market was made, a shaft was sunk to a depth of 110 feet and the company raised in all about 600 tons of good ore. At this depth, however, the deposit becomes irregular and uncertain, and as the ore could not be extracted without the removal of much rock, work was abandoned and has not been resumed since."

Working No. 4.—This consists of a narrow open cut in the rock about 90 feet long. At its eastern end a pit has been sunk which

* Report of Progress, Geol. Surv. Can., 1874-5.

Fournier
mine.

according to our guide went down perpendicularly for about 40 feet and showed about 8 feet thick of ore all the way down. At the mouth of this pit several ribs of ore are visible measuring from 1 inch to 6 or 8 inches thick, the magnetite itself, where it shows, appearing pure.

Working No. 5.—Is a shallow open-cut in the rock about 5 feet deep and about 60 feet long with a surface stripping for another 50 feet south-west from it. Several small ribs of ore are visible as at the other pits.

Other Outcroppings.—Other points where ore occurs are shown on the accompanying plan close behind the barns and 300 yards about W.N.W. from the same. Only small ribs of ore are however visible.

Dip Needle Readings.—Readings were taken at intervals of about ten paces apart along four lines and results have been inscribed on the plan. It will be noted that the average attraction of the district was only disturbed in the immediate vicinity of the pits, or at these points where ore was already known to occur and had been worked.

Ore Characteristics.—All the ore mined during the operations carried on in previous years having been removed, there was no opportunity to judge its characteristics. From its mode of occurrence, however, and from what little was lying around, it is evident that the intermixture of foreign material would mainly consist of hornblende, pyroxene and mica.

Mr. Vennor in his report states that the ore is free from titanium and this would seem to be borne out by the analysis of the specimen collected personally, which is given in the tabulation at the end of this report. The remarks upon the proper interpretation of assay results given in the Introduction must however be borne in mind.

ALLANS MINE.

North Crosby Township, Con. IV., Lot 27.

Allans mine.

Time allowed of but a hurried visit to this place. According to our guide, Mr. Fournier, who resides on the next lot north of this, the points visited comprised all the work done on the deposit.

These consisted of a couple of shallow strippings, about 25 by 40 feet and about 50 feet apart. The surface rock had been blasted away for a few feet down from the surface. The surrounding rock is a dark basic variety apparently very similar to that of the Fournier mine

above described showing at places magnetite in small ribs and veins, Allens mine, etc.

The work was in such a condition that but little could be determined as to the important features of the deposit.

Our guide, who worked at the mine when it was in operation, stated that no ore was shipped. Nothing could be seen representing ore extracted, except some small piles which might represent in all about 20 tons of material. If these were seen as ore, the grade would be low from the very large admixture of rock material. As however Mr. Vennor's description of this place speaks of 100 tons of ore as having been raised, either the good portion of that extracted must have been shipped away, or some other excavations must exist which were not seen.

An analysis of a specimen of this ore was made by Dr. Sterry Hunt and will be found in the tabulated assays at the end of the report. It shows the mineral to be low in phosphorus but somewhat high in sulphur and titanium.

CHRISTIE LAKE MINE.

South Sherbrooke Township, Con. III., Lot 18, 19 and 20.

The workings going by this name are situated on the shore of Christies lake at a distance of about twelve miles W.S.W. from the town of Perth. The examinations made were of the workings on lot 18. They are situated on the steep slope of the north shore of Christies lake and the distribution of the different pits is shown in the accompanying sketch plan.

Working No. 1.—Is an open cut run for a length of about 100 feet northerly into the base of the hill close to the shore and a little above the level of the lake. The floor of the cut is only level for a short distance after which a step about fifteen feet high is encountered, beyond which the floor of the cut rises at an angle of about thirty degrees, following approximately the slope of the formation at this point. This consists of rusty gneissic rock, in which is an ore rib which dips with the rock. Underlying the ore rib is basic gneiss, and lying immediately on top of it, is a salmon coloured, more felspathic member of the series. The basic gneiss crops out beyond, forming the top of the hill being so found as far as followed for a distance further north of about 200 yards.

Christies
Lake mine.

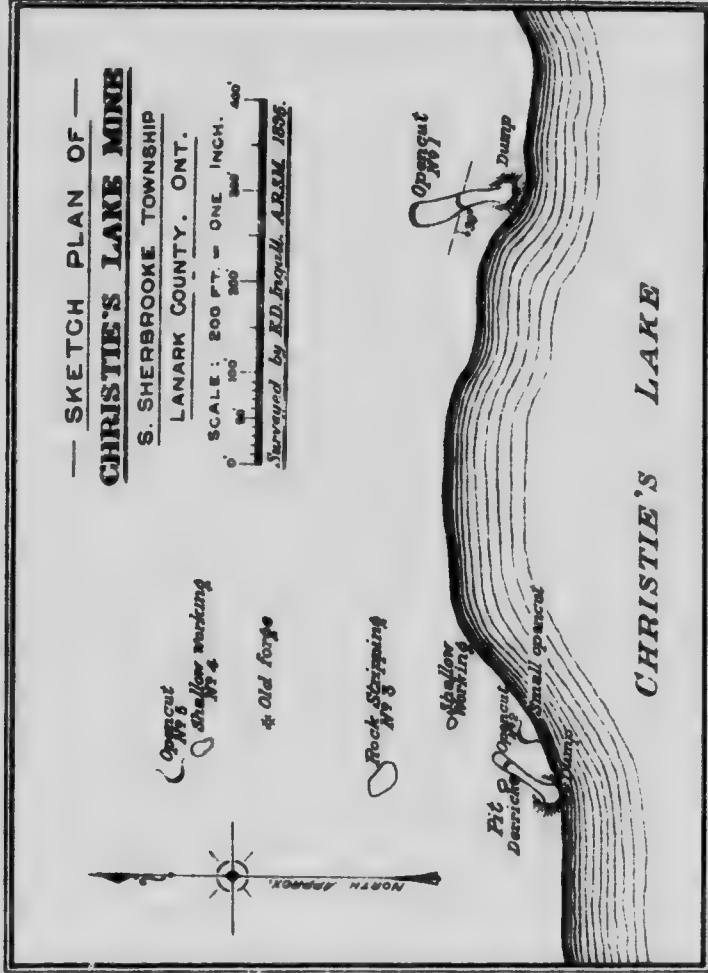
The rocky walls of the working being very much stained with rust a careful examination was made with the pick along the length of the cut where the ore rib was found to have a thickness of but a few inches at the lower end towards the lake, increasing to about four feet at the upper end of the working. This is evidently the place spoken of by Mr. Vennor in his description of these mines in the 'Report of Progress of the Geological Survey, 1872-3, pp. 174-5.' He there says: 'the uppermost lead of ore and the nearest to the lake has been uncovered for about thirty-five feet in length by twenty-four feet in breadth and a considerable mass of ore has been exposed. No walls have yet been reached and I think it is probable that the uncovering has been extended on the face of the bed, rather than across the outcrop.'

It is evident that much work was done subsequent to his observations and that his surmise was correct, the hanging wall rock having been simply stripped off, exposing a certain amount of the back of the ore rib. When this was pierced, however, and its comparative thickness demonstrated, the erroneous conclusions of the miners as to the extent of the ore-body based on the large exposed surface of ore, must have been dispelled. Judging from the general rustiness pyrite is probably present in quantity.

Working No. 2.—About 600 feet further west along the shore, from the last mentioned, is another open cut into the rocky slope of the lake shore. Starting a short distance from the water's edge and slightly above that level, it has been run inward for about seventy-five feet in a north-easterly direction ending in a face about ten to fifteen feet in height. The rock passed through reminded one strongly of the harder and darker coloured pyroxenites of the phosphate district of Ottawa county, Quebec.* Here, as there, irregular centers or vugs occur frequently which are lined with crystals of the rock constituents and throughout the exposure, pink and cream coloured calcite shows in irregular patches and veinlets. As with the phosphate, magnetite occurs irregularly throughout the mass, being perhaps more particularly found in connection with the loose, vuggy portions. At one place a vug was noticed lined with fairly well-defined crystals of magnetite. Pyrite is also frequent at times in patches of considerable extent and pale green apatite was also observed. All these minerals seem to be more distinctly separated out where free crystallization has been possible.

The resemblance to the phosphate formation already noted is rendered more complete, by the presence here also of the curious

* See Appendix A., specimen No. 5.



so-called 'leopard rock' so frequently found in connection with the apatite deposits. Close to the northern end of this open cut and on the western side a pit of small diameter has been sunk to a depth of about 15 feet and at short distances around are several shallow prospecting pits.

Christies
Lake mine.

Working No. 3.—About 125 feet north of the inner end of the open cut just described, is a shallow rock stripping the centre of which shows a surface about 40 by 20 feet of pretty good ore ground. The surrounding rock surfaces are very rusty and rotten, and pyrite seems to be plentiful. Owing to this, and to the way the opening has been made, determination of the essential features of the ore body are rendered difficult. It looks, however, as if it represented an approximately flat lying ore-body from which the overlying rock had been stripped. Thus the exposure of ore surface made, would give no measure of the real extent of the ore-body, its thickness, strike or dip, etc.

Working No. 4.—Is a shallow open cut working in ore the occurrence of which however is irregular.

Working No. 5.—Is an open cut run southerly into the rise of the hill, and having a face of about 10 by 12 feet. There seems to be a good deal of ore in ribs right across, but as elsewhere, the workings are not in condition to give any definite data as to the mode of occurrence.

Dip Needle observations.—Time permitted of but two main lines of readings being taken, which for convenience of reference are designated A. and B. The first (A) beginning on the shore of the lake at the mouth of open cut No. 1, passing up through the open cut was continued in a northerly direction, the whole distance measuring about 600 feet. For the first 200 feet in the proximity of the working considerable disturbance of the needle is recorded, but for the last 400 feet practically no abnormal attraction was noticed.

The second line (B) commenced at the shore at the mouth of open cut No. 2, proceeding in a direction about N.E. for about 150 feet alongside the cut. The readings were then continued about northerly to No. 4 working, for some 300 feet, and thence north-westerly past workings 4 and 5 for about 100 feet. The only noticeable disturbances of the needle were shown along the first 150 feet in the vicinity of No. 1 open cut and adjacent workings. For the remainder of the distance no local attraction was shown.

Christies
Lake mine.

Besides the above, investigation was made for local attraction at a number of other points. Readings were taken every few feet along the lower and outer bench of open cut No. 1, as well as along the length of open cut No. 2, no attraction being found in either case. Readings of the needle were made every few paces from working No. 2 to working No. 3, and all around these workings thence southward to the shore of the lake every few paces, but no attraction was shown except at one point near the S.W. edge of the stripping. Around the workings Nos 4 and 5 no attraction was found except where the needle was held close to the small ribs of ore showing.

General Observations.—At this mine the ore where exposed all occurs in the gneissic rocks. Limestone however probably occupies the floor of the lake near the shore as the general strike of the formation in this vicinity being about N.E. and S.W. would locate there the continuation of the band of that rock, which shows on the lake shore about a mile eastward of the mine. This supposition is borne out by the occurrence of a large island of limestone almost immediately in front of the workings about a quarter of a mile out from the shore. About 200 feet west of open cut No. 2, limestone occupies the shore line for a distance of about 200 feet, but does not appear to pass inland and is probably just a fringe of the main band already alluded to.

The unsatisfactory way in which the development work has been done, the second growth bush, and the general conditions, render it very difficult to decide upon the relationships of the different exposures to each other. It is further hard to make the workings above described coincide with the description given by Mr. Vennor in the report of progress of the Geological Survey for 1872-73. The first mentioned opening of his description seems to tally with open cut No. 1 above described, but beyond that I was not able to follow the description on the ground. This may have been on account of work done subsequent to his visit.

Judging, however, from all the features presented at the various points where ore is exposed, as far as those visited are concerned, the mode of occurrence would seem to be more likely to be as elsewhere in the district, viz., irregular deposits in basic gneissic rocks, rather than that these should be interpreted as they were formerly as points on the outcropping of several continuous beds of ore underlying each other. The dip needle results also as far as they went would seem to weigh against the latter probability

The two open cuts on the shore were connected and surveyed in with plane table and micrometer, but the inland workings had to be sketched by means of compass and pacing.

Mr. Vennor's description before alluded to, gives also an analysis of a specimen of the ore by Dr. Harrington, then chemist to the Geological Survey*. From this it is evident that the ore at this place resembles that at the Chaffy mine in being more or less titaniferous. The percentage of phosphorus would probably depend upon the care with which apatite was looked for and sorted out when it was found to occur in places in the deposit.

South Shore Workings.—Mr. Vennor mentions some work which was done on the south shore of the lake about opposite those above described. The ore is said to have been of good quality, but does not appear to have occurred in quantity and the work done was not extensive.

SILVER LAKE MINE.

South Sherbrooke Township, Con. IV., Lot 16.

A visit was made to some workings about a mile W. from the Christie's Lake mine. These were situated on the east shore of Silver lake. Mr. Vennor in his report to the survey mentions some more extensive workings as occurring on the south side of the lake on lots 13, 14 and 15 in the same range. Notwithstanding that, our guide showed those on 16 as constituting the Silver Lake mine, the two places are evidently distinct.

At the place visited a small cut (A) about 30 by 20 feet had been opened out in the side hill rising from the shore of the lake. The working is near the water's edge and its face rises about 12 feet above the level of the same.

This opening has been made in a dark compact hornblendic rock. An examination of the walls extending around the sides of the workings showed only very little magnetite, as if the whole body had been taken out leaving a little of the mineral attached at a few places around the edge. In judging the material which has come out of the opening and assuming that the more carefully made pile is the ore, it would seem that the latter represents but a more magnetiferous portion of the basic rock in which the excavation has been made. But little pyrite was noted.

About 100 yards in a southerly direction on the shore of the lake is an exposure of dark crystalline hornblende, reticulated with ribs and veins of magnetite, and showing occasional irregular areas of the

* See table of analyses, Appendix B.

Silver Lake
mine.

'leopard rock' before alluded to as occurring at Christie's Lake mine. Between these two points are several insignificant shallow workings in the hornblende rock.

On the south-west side of these basic rocks a coarse crystalline limestone outcrops skirting along the shore. It shows numerous and curious inclusions of the dark basic rock, which are often twisted and frequently have a corroded surface. At a point a few rods northerly from the main working a forked tongue of the crystalline limestone penetrates the dark basic rock.

Dip Needle Readings.—A line of readings with the dip needle was taken in a north-west and south-east direction between the southerly exposure on the shore and the main pit, and continued beyond that point for about 200 feet and a line also at right angles to this crossing the main pit, extending about 250 feet from the lake shore. South of the large pit the attraction appears to be strong on the average, with some evidences at one or two intermediate points of possible occurrences of magnetite. To the north of this pit no attraction out of the normal was found to exist.

Along the line crossing the large working in an easterly and westerly direction from the shore inland for some 250 feet, but little disturbance of the needle was shown.

The next described form a range of mineral properties on a line running roughly E.N.E and W.S.W. upon which have been made a few openings on small bodies of magnetite. The particulars noted at each place are as follows :—

RITCHIE MINE.

South Sherbrooke Township, Con. VII., Lot 16.

Ritchie mine. At this point a small test pit had been sunk to the depth of about 10 feet, in which were visible two exposures of magnetite, one on the south side, and the other on the north side of the pit. These ore ribs for the few feet exposed, seem to follow in a general way, along the strike of the inclosing gneissic rock which is about east and west. The dip seems to be to the south 40° on the north side, and about 60° on the south side.

The section exposed in the east end of the pit, shows the two ore ribs separated by pale pink felspathic gneissic rock a few feet in thickness, in which the structure is marked by thin streaks and bands of a

dark mineral probably hornblende. Judging from the trend of these, Ritchie mine, there is here a small overturned synclinal bend in the gneiss, and the two ore-exposures are probably portions of a single rib following the same bend. At the west end of the pit the ore-rib seems to thin out very considerably.

A number of vugs or cavities occur both in the ore-ribs and at the bend in the rock between them, and these cavities are lined with well formed hornblende crystals. An irregular development of calcite at the west end of the pit seems also to be part of the ore-formation. A little mica seems to be associated with the ore in the calcite portion of the deposit, and the magnetite sometimes occurs in rounded nodules in the vein in a granular matrix of mixed magnetite and hornblende. The inclosing rock seems to be a somewhat basic gneiss.*

In the pit above described the ore occurs associated with a more acidic variety in which the heavier minerals, hornblende, etc., are represented only by the dark streaks and lines of crystals marking the parallel structure of the rock.* A little distance to the south of the pit, however, the proportion of hornblende, etc., is much larger giving a darker and more basic gneiss.†

About 100 feet south of the above described ore occurrence, a similar ore exposure shows lying about parallel with the same. It is about 2 feet thick and showing for a length of about 6 feet. Between the two is a cropping of a narrow band of crystalline calcite similar to that showing in the pit.

The ore consists sometimes of a coarse granular aggregate of magnetite sometimes of that mineral in more compact masses showing a vitreous fracture.

MORROW MINE.

South Sherbrooke Township, Con. VIII., Lot 13.

About a mile W.S.W. from the last described, is the property Morrow mine. known as the Morrow Mine. A small pit about 15 feet in diameter by about 10 feet deep, has been sunk on what appears to have been a small pocket of magnetite in the basic gneiss of the vicinity. The rock here as at the Ritchie Mine strikes about east and west.

The magnetite occurs sometimes massive with a vitreous fracture, sometimes with a loose pebbly structure like an interferent aggregate

See Appendix A: * Specimens 16 & 16 b, c & d. † Idem Specimen 16a.

Morrow mine. of crystals, the grains being at times roughly octahedral in form, and again as a mass of magnetite and quartz. A little admixture of mica shows in the ore pile and apatite is to be recognized not infrequently. A good deal of rust is present from the decomposition of the pyrite, which judging from the waste dump appears to have occurred plentifully and in large pieces in the deposit, which was evidently characterised by the presence of vugs and cavities lined with quartz and crystals of black hornblende.

MABERLY PROPERTIES.

Maberly properties.

An extension of the ore-bearing belt, in which the two last described properties are situated is claimed as having been proved for about five miles to the W.S.W.

This belief of the owners of the properties seems to be based upon the evidence of the dip-needle, as no development work has been done. A day was spent in making a partial examination of this range of country with the dip-needle, but it is evident that no very definite conclusions could be arrived at by any one without making a complete and systematic magnetic survey.

Commencing at lot 15, Con. V., Oso Tp., considerable attraction was shown at a number of points along a distance of about three miles to about lot 9, Con. IX. in South Sherbrooke. Whilst, however, these heavy dips were shown at isolated points, the attraction between these points was found to be light. In fact, failing more complete observation with the needle the evidence so far adduced would lead rather to the belief in the existence of a basic belt of gneiss carrying probably a fair proportion of magnetite as one of the constituents of the rock, that mineral being more concentrated at spots. At these points when located by a systematic magnetic survey, development work might prove the existence of aggregations of the magnetite into bodies of sufficient purity and extent, to be profitably worked. The rock cropings observed along the distance traversed corroborated this view, consisting as they did of a basic hornblendic gneiss, very similar to that described in connection with the Morrow and Ritchie properties. On lot 15, con. V., Oso Tp., this rock was found at places to show a considerable proportion of disseminated magnetite and some pieces of pure ore were also obtained.

FARREL'S LOT.

Bathurst Township.

On the road between the Fournier mine and the east end of Christie's Farrels lot. Lake on the lot of Mr. George Farrel an interesting occurrence of magnetite was visited.

The mineral occurs in a little outcropping of crystalline limestone or calcitic rock, in a pasture. All around appeared the basic gneissic rock so common in the district, in such a way as to seem to quite surround the limestone which is cut at this point by a coarse pegmatite dyke. The magnetite occurs as isolated nodules throughout the limestone, and as protuberances from the walls of the waterworn channels and little caves that traverse it. These were the only features noticeable in the very short time at disposal for the examination, but it is worthy of record as a curious association in which to find the mineral. It would require a much longer time and closer study to throw light on the mode of origin of the magnetite at this place.

FOLEY MINE.

Con. VIII., Lots 10 and 11, Bathurst Township.

The workings that went by this name are situated about eight miles west of Perth. The existence of magnetite deposits at this place was mentioned by Mr. Vennor, in the Report of Progress of the Geological Survey for 1870-71. He also drew attention to the frequent admixture of crystalline green apatite with the ore, the presence of which mineral was also noted during my examination. A number of openings have been made on lot 11, toward its southern end. One was 10 feet deep, another being full of water, the depth could not be ascertained, and all the openings were small. The ore occurs in what seems to be a dark basic rock which crops out all around and is apparently for the most part compact in structure although at places there is some semblance of parallel structure. At places mica and hornblende occur in large crystals.

In examining the pits by chipping all round, no evidence could be found of any extension of the different ore-bodies, but as far as could be ascertained they were circumscribed by the inclosing rock. This was clearly the case in one pit.

Foley mine.

No limestone shows in the immediate vicinity, and its mode of occurrence strongly recalls, as mentioned in other cases, that of the apatite in Ottawa County, Quebec, viz.: irregular aggregations of the mineral throughout an area of basic rock. The peculiarly compact structure of the magnetite and its very vitreous fracture is in marked contrast with the duller lustre and granular or cemented granular structure, chiefly affected by the contact deposits of the district.

On lot 10 very similar conditions were observed. The developments made consist of three pits on a northerly and southerly line and rather more extensive than those on the last mentioned lot. They cover a distance estimated at about 150 yards. The ore having been practically all removed it was impossible to determine the presence or absence of apatite or pyrite. None was found however in what little mineral was yet found scattered around.

The pits are irregular test shafts the most southerly one showing a depth of about 25 feet above the water, and the most northerly one about 15 feet. The latter had been worked by means of a derrick. The middle pit was too much caved in to enable much to be observed, but the rock around seemed to be all similar to that already described.

At places in the vicinity, a coarse granitic structured rock outcrops apparently pegmatite. As far as could be ascertained in a short and hurried examination and with so small an amount of development made, the impression left was that of coarsely aggregated pockets of magnetite with hornblende, apatite and pyrite, in an area of diorite.

In his evidence before the Ontario Mineral Commission, 1889, Mr. Bawden states that two car loads of good ore was taken out from work done on lot 12, and that twenty years previously, some ore from this point was shipped to Cleveland, Ohio, where it was tested and reported upon favourably

WILBUR MINE.

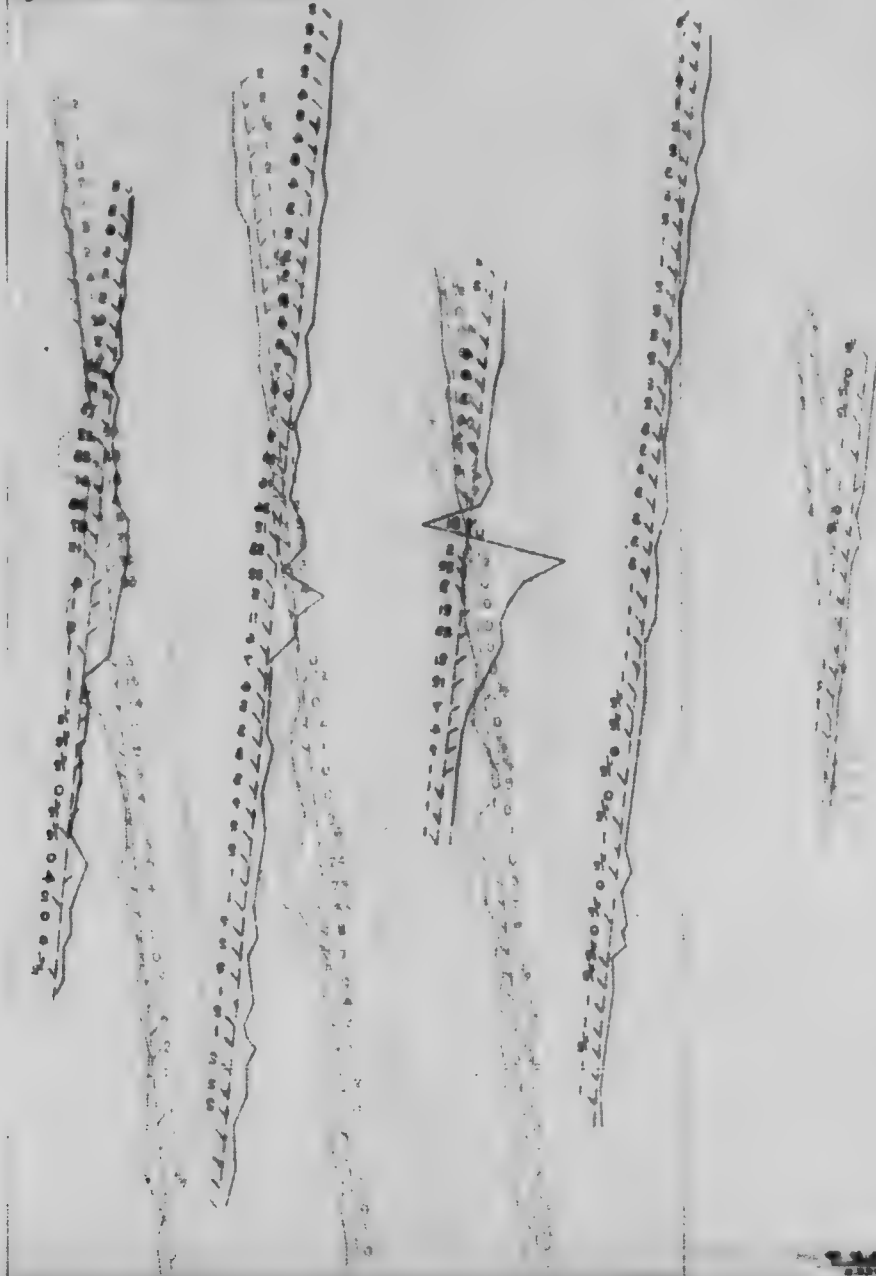
Lavant Township, Con. XII., Lots 3 and 4—Con. XIII., Lots 3 and 4.

Wilbur mine.

The chief pits at this mine are situated on lot 4, in Con. XII., the workings also crossing the S.E. corner of Lot 4 in Con. XIII., and the N.E. corner of lot 4 in Con. XIII. A siding about a mile in length, connects the workings with the Kingston & Pembroke Railway.

The most easterly workings are situated upon a hill which slopes northward down to a beaver swamp. Passing westward along the

THE TOWN OF
ST. LOUIS, MO.
1892





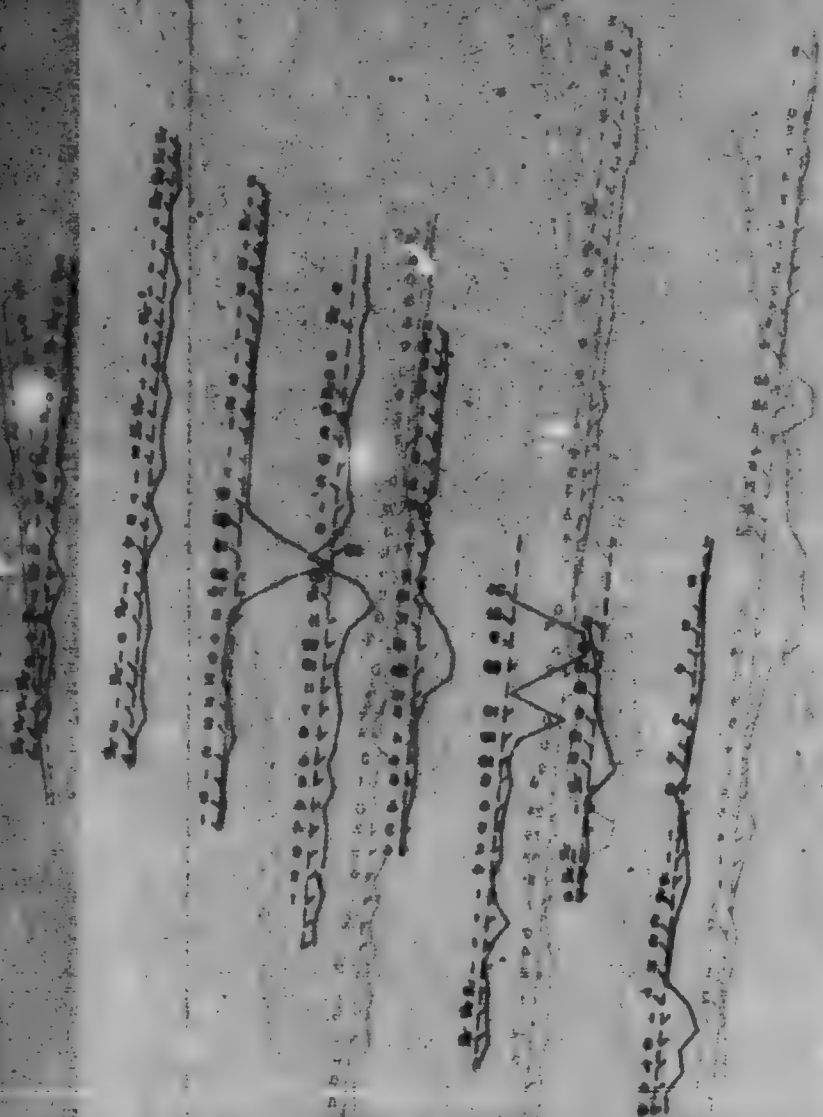
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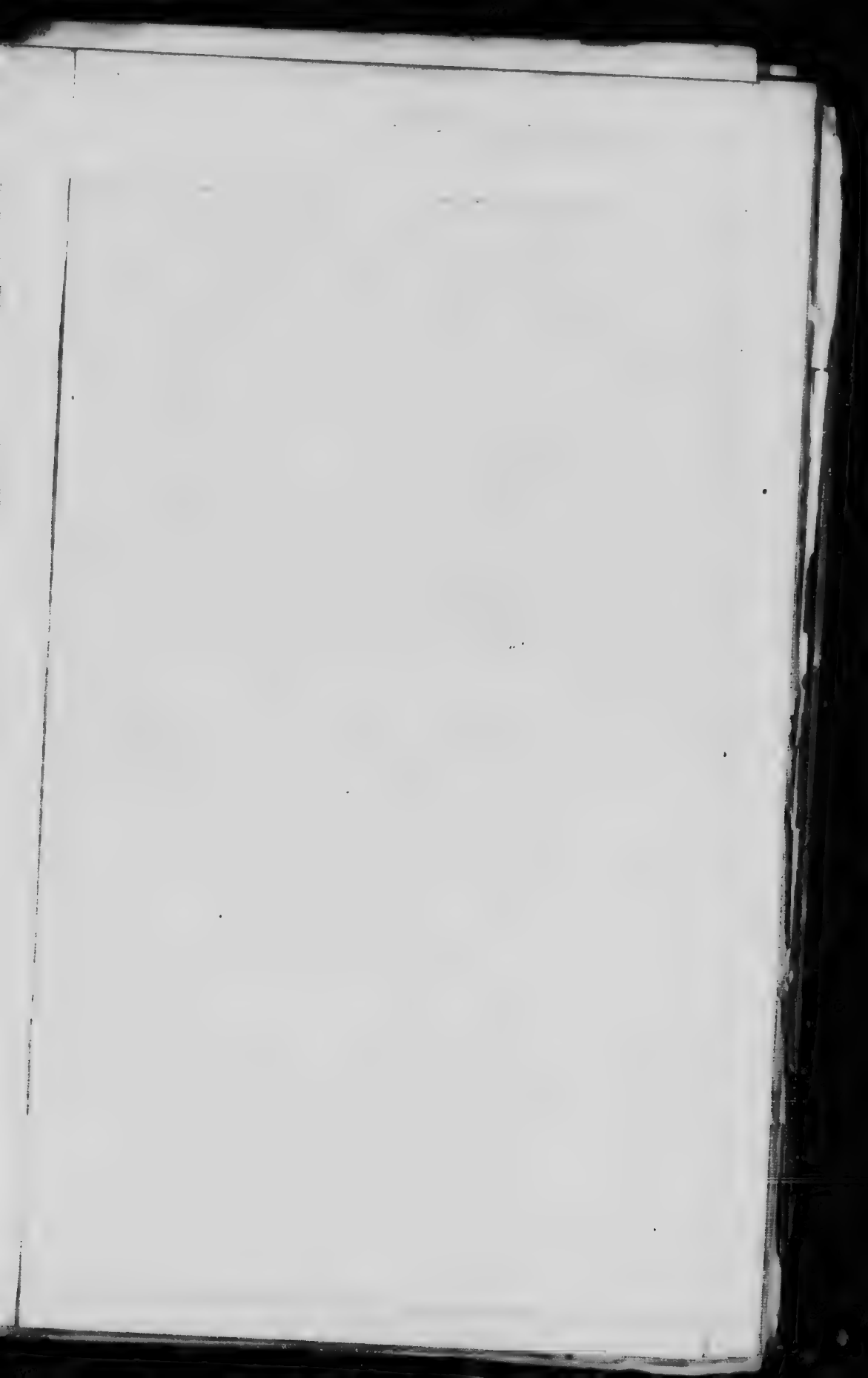
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Graphic of the ...



PLATE
No. 10 of the series of plates illustrating the
geology of the State of New York
by W. M. F. MEAD





— WILBUR MINE —

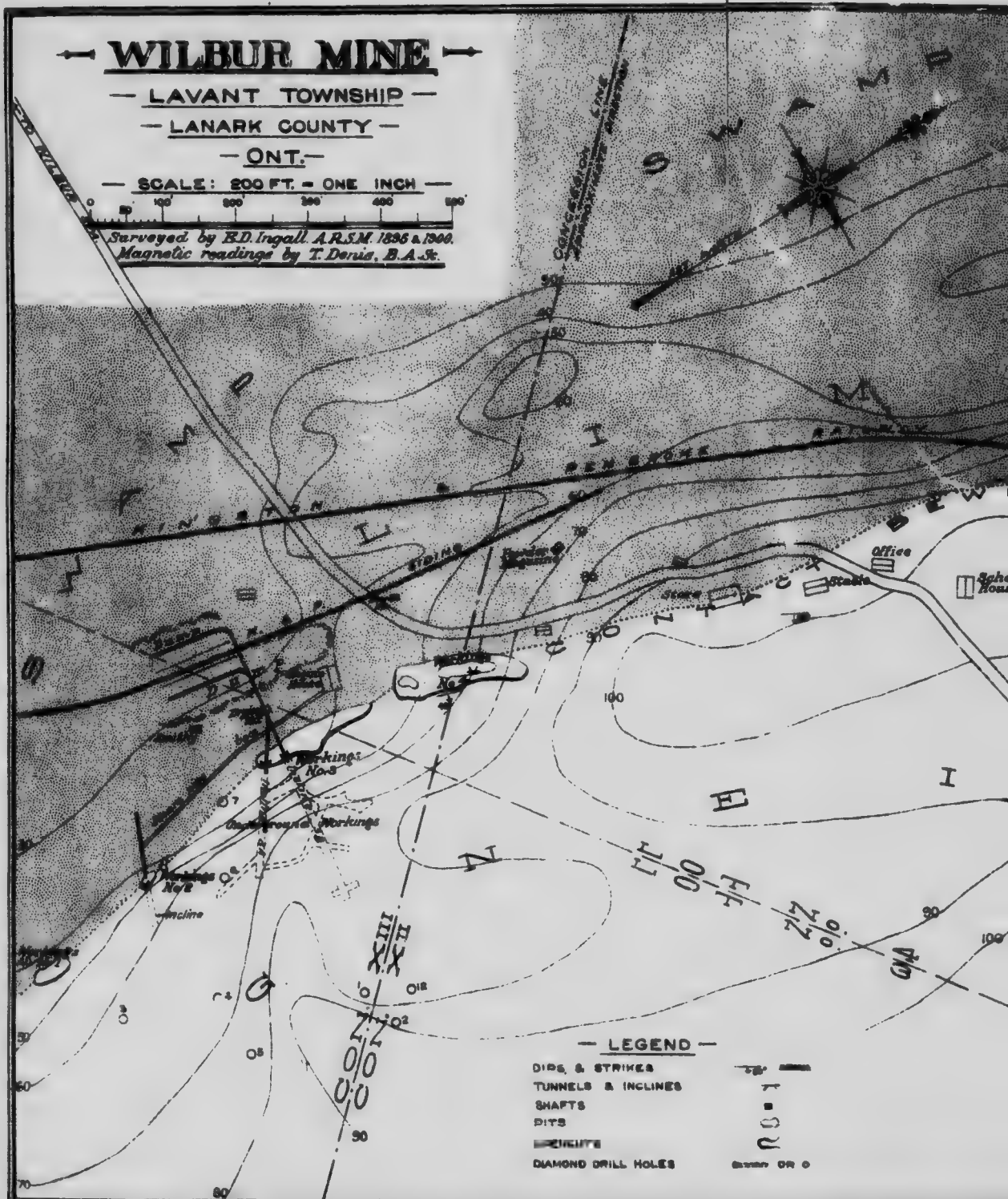
— LAVANT TOWNSHIP —

— LANARK COUNTY —

- ONT. -

— SCALE: 200 FT. = ONE INCH —

Surveyed by E.D. Ingall. A.R.S.M. 1896 & 1900.
Magnetic readings by T. Denis, B.A. &c.





line of pits, the edge of the ridge is passed over, so that the most westerly pits lie at its base, and are therefore much lower than the last mentioned. The line of pits is curved, but the strike of the chain of ore-bodies would average about N.E. The dip the formation and of the workings on the ore varies from 25 degrees to 40 degrees in a southerly direction, which, taken with the rise of the hill, partly accounts for the curve in the line of pits. At the east end, however, there seems to be evidences of contortion of the formation but the relationship of the worked ore-bodies to each other, and to the inclosing rocks, is somewhat confused, and the time at disposal did not allow of sufficiently detailed work to decide these points. The accompanying plan shows the detail of the workings.

Commencing at the foot of the hill and working eastwards up the slope, the description of the different pits is as follows:—

The workings numbered 1, 2, 3, 4 and 5 are all in the gneiss or close to its contact with the underlying limestone.

Working No. 1.—Consists of a shallow pit abandoned a long time previous to the examination.

Working No. 2.—Here an incline has been sunk at a point where some shallow surface pits had been previously made. At the time of examination, however, nothing could be seen, the excavation being full of water.

Working No. 3.—At this place is an open cut about 160 feet along the outcrop of the ore-body, the incline shaft shown on the plan having been sunk below its western end. Work was progressing at the time of the visit made, so that some features of the deposit could be seen. In inaugurating the present operations, the old workings were unwatered, and drifting was done to connect the old or westerly incline (3a) with the new incline (3b) sunk to the east of the same, as shown on the plan. Connection was also made with the old excavation below working No. 4.

The old shaft (No. 3a) is inclined at about 30 degrees down to the first drift, after which the excavation is continued on the level to the end. All the drifts shown are on this level, the incline (No. 3b) in its downward continuation, passing below them at an average angle of inclination of about 14 degrees. The formation flattened out in depth, the inclination of the upper part being about 27 degrees, whilst below it flattens off in places to as little as 8 to 10 degrees.* Numerous long

* According to the latest information received. January 1901 this incline had attained a depth of over 330 feet.

Wilbur mine. holes have been put in with the steam drill at various points for the purpose of testing the thickness of the ore-body at various points in the workings.

Working No. 4.—This, at surface is also an open pit of irregular shape and dimensions, extending some 180 feet along the outcropping of the ore body. Here as at No. 3 the ore occurs in the gneissic rock close to its contact with the underlying limestone. The underground features at this point could not be studied, descent being prevented by debris at the mouth of the pit, and water filling the excavation in depth. At the surface the dip seemed to be about 30 to 40 degrees to the south-east. The workings at this point are said to have extended to a depth of about 250 feet.

Working No. 6.—Is sunk vertically at the base of a small boss of the gneissic rock which is well shown also in the adjacent rock-cut through which the track passes. Here also owing to the water, only surface features can be noted. It is said however that several bands of ore were passed through. On the east side is a wall or 'slip' dipping steeply about north east, which may be a fault plane in the formation, and partly account for the irregularities already noted as existing east from this point.

Working No. 7.—The next development of importance is situated on top of the hill, and judging from the size of the waste dumps must have been extensive. The pit is, of course, full of water, but as the walls of the excavation rise some ten to twenty feet above its surface, somewhat can be judged of the conditions under which the ore-body exists. This pit is stated to have been sunk to a depth of about 300 feet on the incline. The dimensions of the ore-body seem to have been irregular and it is stated to have varied from but a slight thickness to sixty feet in thickness.

At this point the strike of the rocks would seem to indicate a local turn or twist in the formation, and the dip of the ore-body as followed down in the workings, would be at an angle of about 30 degrees north-east, as contrasted with the Easterly dip shown in the western workings. This interpretation of the phenomena must however be taken as provisional only, as most of the data necessary to corroborate it are lacking. Had time permitted when the examination was made, more dips and strikes might have been observed, and with these and the details of the underground work, it might have been possible to arrive at some reliable conclusions. For the same reason the exact distribution of the rocks, as shown on the plan, is subject to correction, but the lines drawn are such as the data at command would seem to

indicate. The eastern limitation of the gneiss-covered area, together with the detached portion of the same, lying between No. 7 and No. 8, would seem to owe their position to the removal of the overlying gneissic rock in the low ground between No. 6 and No. 8 by denudation, but as most of this area is swampy, and rock exposures are therefore scarce, this also is partly conjectural.

Working No. 8.—These pits were so full of water, and the inclosing rocks, so obscured with cover, that there was little to note regarding them. Considerable work seems to have been done however.

Working No. 5.—In the distance between the pits Nos. 3 and 4 and those at the western end of the property, there are a few unimportant workings (No. 5). They consist of a little tunnel, run in just below the brow of the ridge, at a very slight depth below the surface; of a little opencast working, and a couple of small test shafts as shown. Nothing of importance seems to have been developed there. These excavations all seem to be in the lower part of the gneissic rocks overlying the limestone.

Diamond Drill Explorations.—The diamond drill has been used to a considerable extent at this mine, and the position of some twenty-seven holes are marked on the plan.

The fifteen holes lettered 'K' to 'Y' were put down some years since during the early days of mining at this place and only fragmentary information exists in regard to them. As far as can be learned many of these were quite shallow. Of the longer holes, the deepest was 350 feet. Of the five of which any record is available and which pierced the ore formation, the ore passed through is reported to have varied in thickness from 3 to 28 feet. It is regrettable that no records are available, as without these and the cores it is impossible to properly interpret even the data available and much is lost which might have helped materially in unravelling the geological structure and the relationship, distribution and dimensions of the ore-bodies.

The holes numbered 1 to 12 have been put down recently to varying depths of from 60 to 175 feet. The records of these are not available for publication, but it is stated that ore was encountered in all except one, ranging in thickness from 5 to 15 feet. The widespread distribution of ore is thus shown and the thicknesses of the ore-bodies are in a measure given as these western holes were all sunk at right angles to the general dip of the ore zone. In the case of irregular deposits however, such as exist in this district, the indications of the drill, whilst invaluable as a guide, must be used with judgment, as in the

Wilbur mine. nature of things, considerable changes in thickness, etc., are apt to occur in quite short distances.*

Magnetic readings.—The magnetic curves shown on the plan, give the results of the observations made with the dial compass and dip needle. They are unfortunately rather few in number for the purpose, on account of the limited time at disposal. Although no detailed conclusions can be drawn from them, they illustrate, however, certain general features. In speaking of them they will be referred to in their order, numbering from the east.

It will be seen that along the chain of ore-bodies from workings Nos. 5 to 9, the zone of magnetic disturbance coincides with the known distribution of the ore-bodies, and, in some cases, as with line 6, gives evidence of ore where no openings have been made. Along line 1 there appears little or no evidence of magnetic material. Lines 7, 8, 9 and 10, would seem to indicate an absence of any considerable ore-bodies near the surface, in the distance between the eastern and western groups of pits. Along lines 11 to 16 we have again a zone of magnetic disturbance coinciding with the run of the ore-bodies near their outcropping, as well as some indication of ore, at the southern end of the last mentioned line. At this point the rise in the ground and the dip of the formation would probably remove the needles from the influence of the ore zone which outcrops at the pits, so that the attraction shown may be due either to another ore-body lying higher in the formation or to a higher position of the original one due to faulting.

In order to arrive at more detailed conclusions, it would undoubtedly be necessary, to take magnetic cross-sections as close as every 20 or 25 feet, but the preliminary lines run, bring out the broader features. In studying these, the following points must be borne in mind. The cessation of magnetic disturbance in passing south, is by no means to be attributed to the termination of ore in depth, as the southerly dip of the formation and the rise in the surface of the ground, would soon remove the instruments out of the range of influence of the deeper parts of the ore-bodies. The continuation of the lines for a distance on the hanging wall sides serves the purpose of exploring for any possible bodies higher up in the formation and similarly their extension north serves to demonstrate the presence or absence, in the limestone belt, of the footwall side, of other deposits, which being either covered or not coming quite to the rock surface, might yet demonstrate their presence by their influence on the magnetic needle.

* An instance of this is recorded in a letter recently received from the owner wherein he states that the underground development had gone through 27 feet of solid ore in the vicinity of a hole which had only passed through about half the thickness

General Observations.—From the study of the general features on Wilbur mine, the surface and those brought out in the developments made, it would seem that the magnetite occurs as a series of detached ore-bodies in the gneissic rocks at their contact with the underlying limestone. This contact is fairly sharply defined at places, as shown in the western workings but, in the vicinity of the eastern pits, the two series of rocks seem to be separated by an alteration zone of greater or less thickness. In this are to be found chlorite, epidote, etc., evidently the products of decomposition of the mineral constituents of the gneiss. Judging from the dumps at pits Nos. 6 and 7 the ore must have been associated with large quantities of chloritic schistose material probably forming an envelope for the same, as it was seen to do elsewhere in the district. The drill holes Nos. 8, 9 and 10 passed through much of this kind of material and frequently for many feet the cores were composed entirely of epidote. Several ribs of unaltered gneiss were also pierced, alternating with highly chloritic and talcose limestone, before the solid limestone was encountered.

In the cores examined from the western drill holes the same features were noted only in a less degree. The break between the overlying gneissic rocks and the limestone below seemed to be sharper, although here also detached ribs of gneissic rock were passed through in the limestone below the main body of gneiss above.

All the workings are practically in the gneiss, or in the altered basal portions of the same. From the microscopic examination of one section from a specimen of the overlying rock it has been called a biotite-granite-gneiss*, although of course, microscopic determination of specimens from other parts of the area would probably show variations from this type.

The limestone band shows a great many interesting features. Irregular wavy ribs and seams of white quartz are a common feature and in places occur in such large proportion as to constitute the rock almost a calcareous quartzite rather than a quartzose limestone. This is a common feature even at points quite removed from the contact with the gneiss. Inclusions with the appearance of having been originally gneissic matter, but now more or less completely altered into chlorite, etc., are common, and they all conform in general direction with the banding and strike of the limestone. This rock is white in colour and frequently exhibits all the characteristics of a marble.

* See Appendix A, Specimen No. 19.

Wilbur mine. *History and Shipments.*—This mine was first opened many years ago, and worked at one time for several years under lease by the Kingston and Pembroke Mining Co. It is now being developed by its owner, Mr. Wm. Caldwell, of Toronto, Ont., the leases having lapsed. He has installed a plant with the intention of proving the extension of the ore-bodies in depth, etc. The chief work is being done at pit No. 3, where a small compressor plant for air drills together with a hoisting engine and the necessary blacksmith, repair, and other shops, have been erected. Considerable work was in progress with the diamond drill also, both in this vicinity and as previously stated, at the eastern end of the property also. It is said that during the previous periods of working, some 125,000 tons of ore of a high grade were shipped.

Characteristics of Ore.—Near the lower pits, Nos. 3 and 4, a large pile of ore was stacked, at the time of the first visit made. It measured about 1,000 tons. This was carefully looked over with the result that little or no pyrites was visible. The ore showed a parallel structure, and was seamed throughout with chlorite and calcite, the latter minerals by eye estimate constituting about 10 to 15 per cent of the whole. A small vein of pyrite 6 to 7 inches thick, is said to have occurred along the foot wall in one part of the mine, but it was quite distinct from the ore which could therefore be kept free from contamination with this deleterious ingredient.

RADENHURST AND CALDWELL MINES.

Radenhurst
and Caldwell
mines.

Lavant Township, Con. III., W 1-2 Lot 22. Con. IV., E 1-2 Lot 22.

These properties are situated near Flower station on the Kingston and Pembroke railway, and in case of their being re-worked, would thus be quite convenient to a shipping point. In the short time available it was found possible to make but a general examination of the area, during which the following facts were ascertained.

The developments consist of a number of pits and strippings spread over a distance of about 1,500 feet on a general run E.N.E. and W.S.W. which seems to be the average strike of the formation in this vicinity. The rocks consist of rusty schists and gneisses of various compositions. As usual, the rustiness seems to be due to the presence of a large percentage of pyrite, which by its weathering, stains the rock with the residual oxide of iron. No limestone is visible in the immediate vicinity of the workings.

Working No. 1.—Beginning at the eastern end of this range of openings we found a pit about thirty feet square, and said to be about thirty feet deep. It is in the rusty, schistose rocks, which here dip about 70 degrees south. The pit was full of water, but small ribs of magnetite show on the surface. Radenhurst
and Caldwell
mines.

There seems to be some tendency toward a veiny structure at this point, actinolite, quartz, calcite and other minerals, occurring in a veiny way. The magnetic attraction near the pit is quite strong, the north end of the needle pointing nearly south.

Working No. 2.—Proceeding west about 150 paces two pits close to each other are encountered, which are said to be about eighty feet deep. They are pretty well filled up with debris from the running in of the sides, so that nothing could be here ascertained as to the nature of the deposit, except what can be gleaned from an examination of the dumps. These show a very mixed lot of rock, chiefly chloritic material, with parallel seams and ribs of magnetite, and a small percentage of lumps of pretty good ore.

Working No. 3.—About thirty paces south from the last is a pit said to be about twenty feet deep. It is in schistose rocks which here strike about N.E. and dip about sixty degrees south. Judging from the material in the dump there seem to have been little ribs of magnetite in places, running with the strike of the rock.

Working No. 4.—About 150 paces further west again, is another shaft, said to be 108 feet deep, with a drift to the east about twenty feet in length. It is cribbed and lined, and was full of water nearly to the top when examined. The outcropping around the excavation, however, could be examined and the strike of the rock would seem to be a little north of east with a dip of about seventy degrees south. The magnetite seems to occur as elsewhere in ribs and veins, cutting rusty schistose rocks. At this point is an ore-pile measuring about 600 tons.

Working No. 5.—About 250 feet west from the last is a stripping measuring about twelve by twenty-five paces. The whole width shows a rusty schistose rock with ribs of magnetite.

Working No. 6.—At a distance of possibly 500 feet west from the last mentioned, and on the Caldwell property, are two little pits within about fifty feet of each other. One of these near the engine house is said to be about ninety feet deep, and near it a diamond drill hole has been put down, apparently with the dip of the rocks, said to be about 200 feet in depth. Both these points show at surface a rusty

Radenburet
and Caldwell
mines.

belt of gneiss or schist, about twenty feet wide, impregnated along some bands with magnetite either as plentiful grains intermixed with the other constituents of the rock, or as solid ribs constituting the best ore.

Judging from the general rustiness of the belt running through all these points, and from the evidence of the ore piles, pyrites must be plentiful at place.

YUILL MINE.

Darling Township, Con. V., East half of Lot 25.

Yuill mine.

On this lot a large open pit has been sunk in a body of magnetite. The work was done in 1889-90. At the time of our visit it was partly full of water, the surface of which was about 30 feet from the highest point of the surrounding rock. The pit is about 90 feet in length, about 30 feet wide at its wider end and about 15 feet at its narrower. On the north side is a dark compact, basic rock, the microscopic determination of the inclusions of the same found in the ore showing it to be diorite.† On the south and west the ore body is bounded by limestone. At the narrow eastern end of the pit, the cover and bush prevent the features of the rocks being made out.

The basic rock of the north side is very compact and structureless, except for some little schistose seams running off into it from the pit. Veinlets of white quartz are of very occasional occurrence in both the basic and calcareous inclosing rocks. The limestone shows signs of being much contorted in places and is of a more shaly texture than usual.

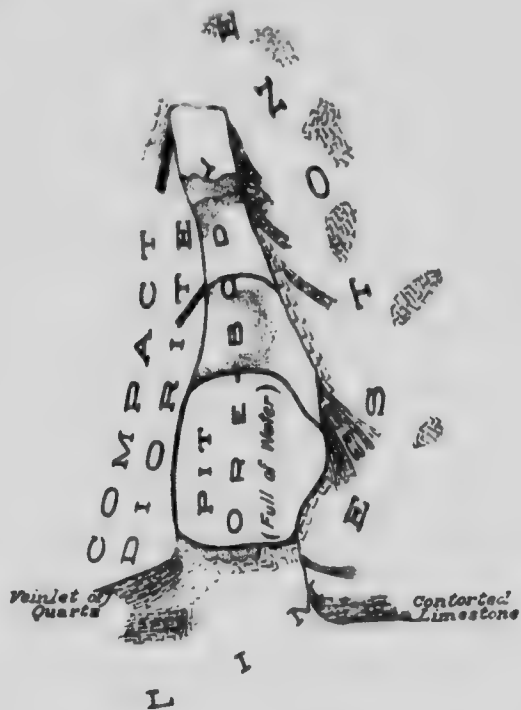
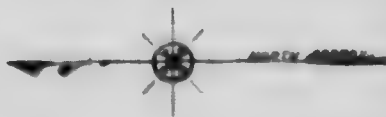
The ore body seems to have ended up against a rather smooth and definite face or wall of the basic rock, whilst where its contact with the limestone is visible, it seems to present more of a mamillated surface, which has a corroded or crystallized appearance.

Ore-dumps.—The ore taken out is all piled near the pit, and measures 50 by 74 by 6 feet, or 22,200 cubic feet, or about 2,700 tons. From an eye examination of the pile, it would seem to be fairly free from pyrite and the sulphur contents should be therefore quite low. Little gash seams of chlorite and calcite seem to be fairly plentiful, constituting perhaps 5 per cent of the whole. The ore comes out in solid lumps, and seems to have a very constant platy or parallel structure, the grain where broken across this structure being fine and steely.*

See Appendix A. * Specimens Nos. 20 and 21. † Specimen No. 21

- SKETCH PLAN -
- OF THE -
- YUILL MINE -
- DARLING TOWNSHIP -
- LANARK COUNTY -
- ONT. -

Approved by F.D.C. 100-1-250 1/25/57



Limestone Outcroppings

One Showing

SCALE OF FEET



BLUFF POINT MINE.

Bluff Point
mine.*Bagot Township, Con. X., Lot 16 and Con. XI., Lot 16.*

The workings going by this name are situated on the south side of the Madawaska river, just where it issues from Calabogie lake, quite close to the village and post office of Calabogie, which is on the other bank of the river. Near by, runs the main line of the Kingston and Pembroke railway, with which the mine is connected by a spur line about a mile in length. The ore-bodies worked at this place occur in a narrow band of gneissic rock, included in a belt of limestone which latter has a width on the ground of about 2,000 feet. Taking the average dip of the formation here as 30° , this would give thicknesses of about 1,000 feet for the limestone, and about 150 feet for the included gneissic belt. The limestone is bounded on either side by dark coloured rocks of the gneissic series, that to the south, a dark heavy basic rock having been determined, at a point near the Campbell mine, about two miles east of this, to be a plagioclase-scapolite amphibolite*; that on the north having more of a schistose character with cleavage surfaces shining brightly with micaceous scales. The microscopic examination of a specimen from the gneissic hanging-wall rock at shaft No. 1 proved it to be an amphibolite.† The strike of the ore bearing belt, and of the formation in general, is about N.E. and S.W.

Shaft 1.—The workings here consist of an irregular open-cut in the outcrop of the ore-body at the west end of which a skip road is seen to descend what is evidently an inclined shaft which is now, however, full of water. The skip road at its mouth has an inclination southerly of about 30° . This shaft is said to be about 300 feet deep with no drifting done from it. The eastern part of this working, consists as stated, of an irregular open cut, the face of which, is at present about 10 to 15 feet high. The width to which this has been opened across the outcrop could not however be ascertained as the bottom of the excavation is now occupied by a waste dump. The face as at present visible, however, shows about 10 feet of grey ground made up about as follows in descending order at right angles to the dip of the ore-body. First the gneissic hanging wall rock, then a foot or so of a green chloritic 'selvege,' then two feet of solid ore followed by a small 'horse' about one foot thick of dark compact rock the surface of which is curiously coated with green foliated crystals of a micaceous mineral, probably

* See Appendix A, No. 4. † Idem No. 2.

**Bluff Point
mine.**

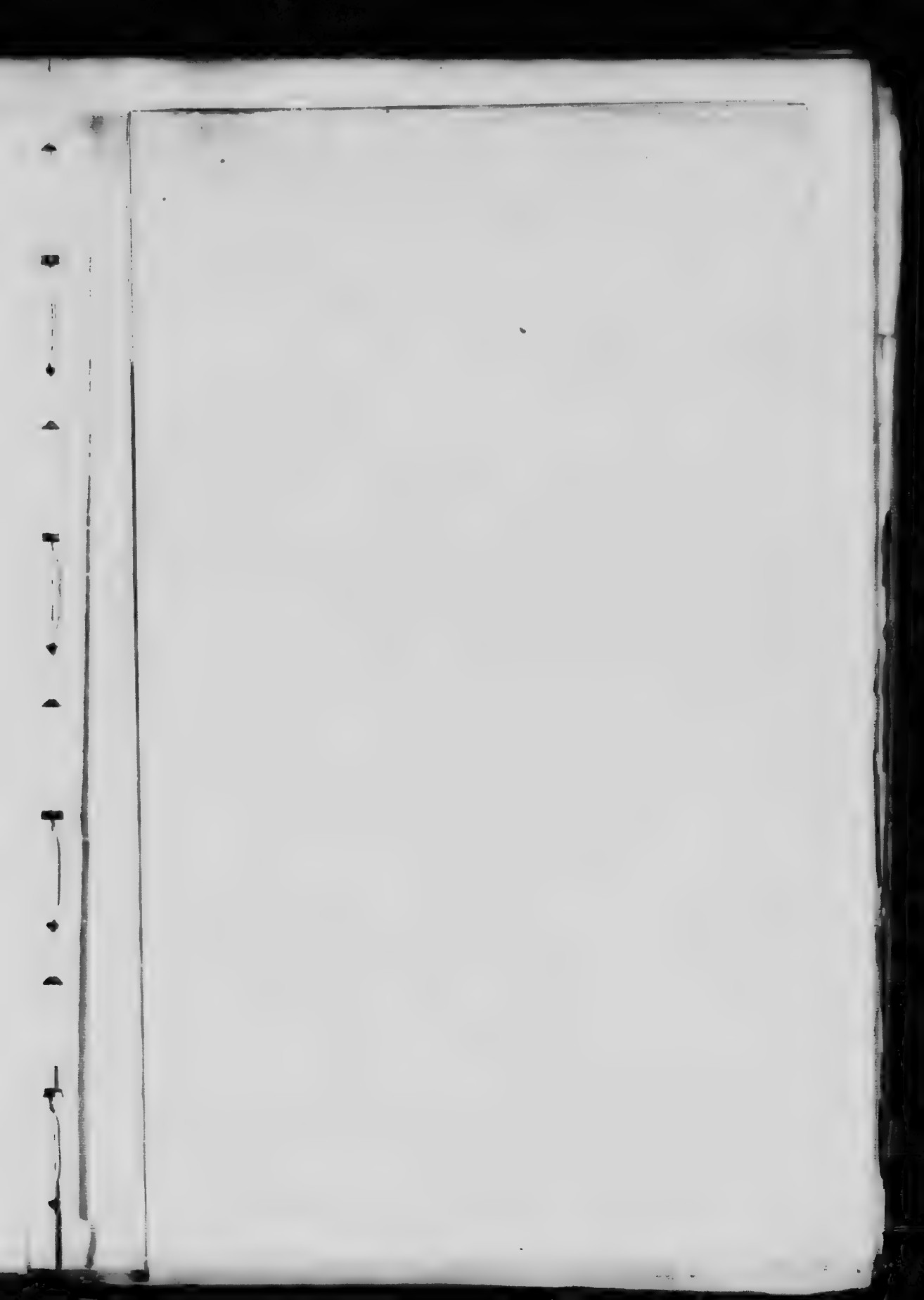
chlorite. Below this about four feet of solid ore and thence down to where the rock face is hidden by the waste material, about five feet of chloritic material with ribs and nodules of ore throughout it. This section is given only as illustrative of the detail of the ore-body at one spot, for here, as elsewhere in the district, it is evident that no such features persist for any distance, and in following the deposit either in length or depth one might run out of poor ground where much rock matter was intermixed with the pure ore, into parts where the mineral was in large bodies, free from such admixture.

Shaft 2.—At this point is a small open cut with an inclined shaft at the bottom. The latter is full of water, so that all that can be seen of the ore-body is its outcropping in the open cut. The cover all round hides most of the features of interest. However, the outcropping shows a rib six feet thick of pretty solid ore besides ore ground above and below the same. Neither wall is exposed, so that it is impossible to state just how much thicker the ore body may be at this place.

Judging from the waste dump the ore here seems to have been intermixed with chlorite, and chloritic and talcose schist. The dip of the excavation as evidenced by the inclination of the skip road above mentioned, is about 40° to the southward and it is said to have attained a depth of about 95 feet. From the bottom of the shaft it is stated that a drift was driven north-east about 70 feet and a large chamber or stope opened out which was said when abandoned to show ore all around with an ascertained thickness of from 8 to 16 feet, without having reached either wall of the deposit. The waste dump at this point consists mostly of chloritic material, and chloritic and talcose schist, in which magnetite often appears in little interfoliated seams, and from this up to more solid seams, the mineral however in the latter case often preserving a foliated structure. Streaks and veinlets of calcite are also frequent and some pyrite shows.

Shafts 3 and 3a.—These are on the next lot to the one last described. The work done consists of a couple of inclined shafts close together. The ore seems to have occurred in the same rusty rotten gneissic rock as at the previously mentioned points. Some specimens of the ore, exhibit similar characteristics to that obtained in the Culhane mines, described later, viz., rusty rotten rock with magnetite in small grains plentifully distributed throughout it.

Shaft 4.—Here a vertical test shaft has been sunk to a depth of 22 feet, in the bottom of which it is said about 5 feet of ore was obtained. The rock showing beneath the thin covering of soil and down to the



SCALE FOR MAGNETIC CURVES





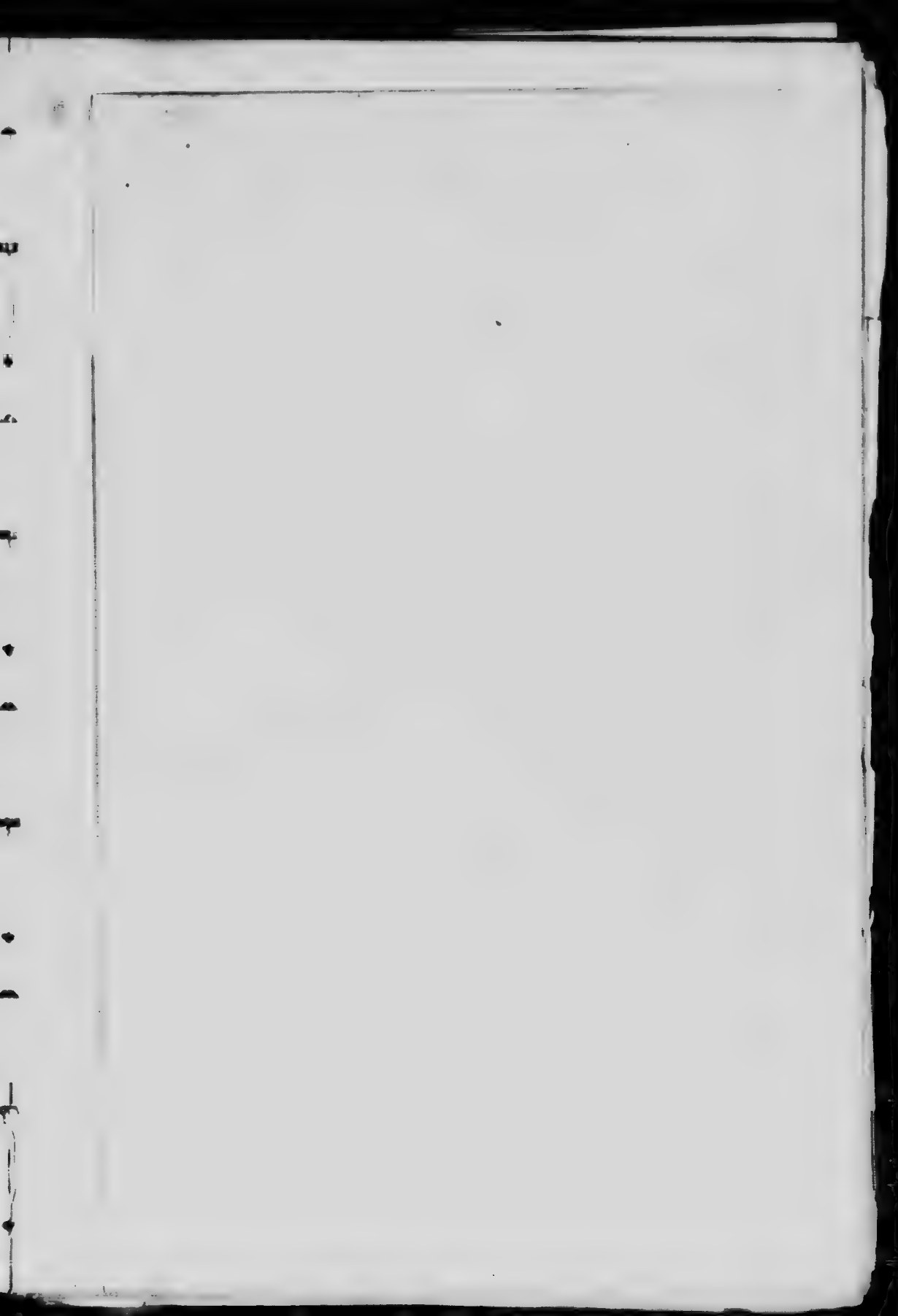
EXPLANATORY NOTE

Readings of the dip needle are shown as curves

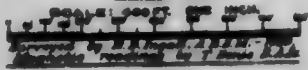
Deflections of the horizontal needle shown thus

meaning 5° N E 30° N W 40° S E 10° S W

SCALE FOR MAGNETIC CURVES



- PLAN OF -
BLUFF POINT MINE
- BAGOT TOWNSHIP -
- RENFREW COUNTY -
- ONT. -



- LEGEND -**
- PIPS & STONES
 - TUNNELS & INLET
 - SHAFTS
 - PITS
 - SPRINGS
 - DAMMED DRILL HOLES





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water at about 12 feet in depth seems to be a schist with occasionally more compact bands. It dips about 30° to the southward curving over flatter to the northward. Bluff Point mine.

Ore Pile.—A large quantity of ore was, at the time of our first visit, piled up ready for shipment. It was not measured, but from recollection there would be about 1,000 tons. It consisted of magnetite, sometimes of rather granular texture, with chlorite jointed through it and a fair amount of disseminated pyrite. By an eye estimate, the rocky admixture in the ore was put at from 5 to 10 per cent. No signs of pyrites were to be seen in the outcrop at Shaft 1, so that unless it has been all weathered away, it is probably absent at that point, which would thus illustrate the features so common in the ore-bodies of this district, sulphur being absent in some parts and not in others.

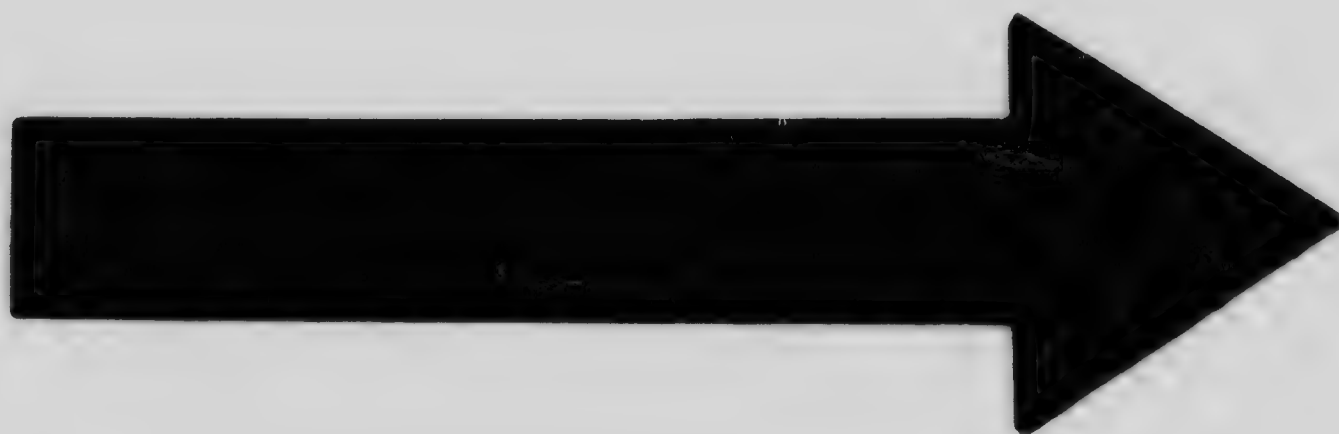
History.—Work was started on this deposit some ten years ago, and for one whole summer it is said they shipped 4 car loads per diem. In 1894 it was opened again and some 700 to 800 tons of ore were shipped to the Radnor furnace in Quebec, and operations have been carried on from time to time since. In 1886 it is said that a vessel load of this ore was shipped to Cleveland and gave such satisfaction, that it resulted in the purchasers of the consignment leasing the mine from the owners. For information on those points not personally obtainable by study on the ground, we are indebted to Mr. J. G. Campbell, of Perth, one of the owners.

Magnetic Readings.—On examination of the curves given on the plan it will be seen that a zone of magnetic disturbance can be traced all along the course of the gneissic belt which carries the ore-bodies. These lines, owing to the limited time at disposal, are too far apart to admit of any more detailed results being arrived at, but they certainly give a very good idea of the possibility of finding other ore-bodies worked in the direction of the road easterly from those.

Bagot Township, Con. IX., West, half of Lot 16.

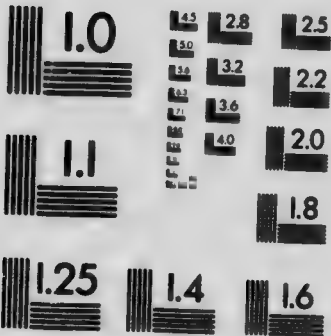
A shallow pit has been made here through the soil at the edge of a beaver meadow on the back of a rib of good solid looking ore which dips at a very low angle southerly. This exposure is said to be about in the middle of the lot. Bagot IX., 16.

A line of magnetic observations was run about 200 yards westward from this point so as to cross the strike of the formation to see if any trace could be had of the eastward extension of the magnetic zone



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noted in connection with the Bluff Point property. The line extended about 1,000 feet either side of the line joining these with the Caldwell and Campbell pits, but no magnetic disturbance was noted.

COE MINE.

Coe mine.

Bagot Township, Con. IX., East half of Lot 16.

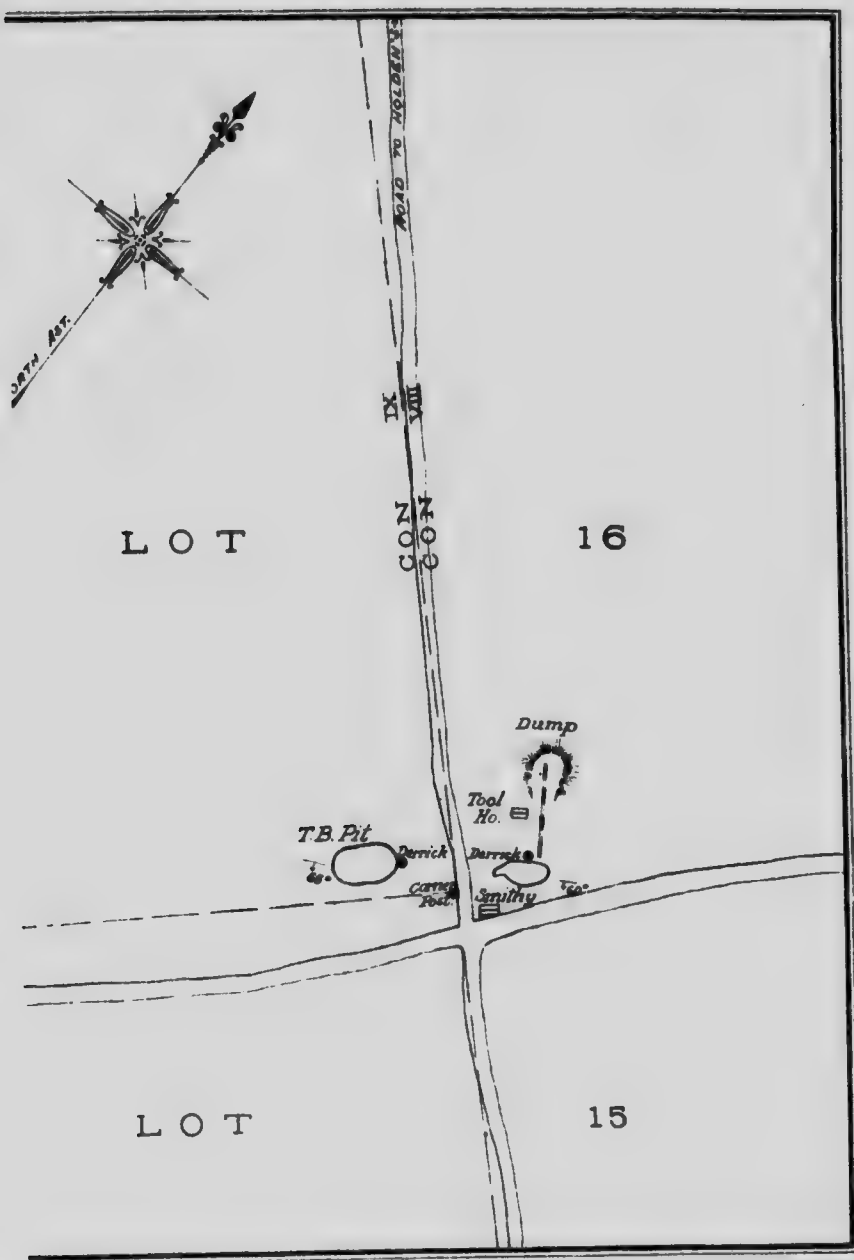
On this lot, which is owned by Mr. Caldwell, of Lanark, a number of ore-bodies have been opened up. Work was begun a number of years ago, and the opening now known as the Jeanette pit was commenced by Mr. Coe, who operated the property under lease. Subsequently the owner had a dip needle survey of the property made, which resulted in the locating of other bodies, development work on which has been done by the Hamilton Steel and Iron Company who acquired a lease of the property. At the time of the examination, made recently, the work was in the hands of individual miners who were taking out and shipping ore to the company on contract. This had to be hauled about a mile and a half by road to the end of the spur line at the Bluff Point mine.

The ore-bodies occur in the dark basic rock already described as bounding the limestone belt of the Calabogie mine on the south and which can be traced along the road located on the lot line as shown in the plan. This has been determined by microscopic examination as amphibolite.*

No limestone could be seen or heard of as occurring in this vicinity in conjunction with the occurrence of the ore-bodies as it does two miles further west. A traverse was made right through to the river along the concession road between VIII. and IX. and across the cleared land of the Holden farm to the north. Along this distance of about 3,000 feet, however, no trace could be found of the limestone belt which, with a width of about 2,000 feet has a strike at the Bluff Point mine which should cause its appearance here. At 500 feet south of the T. B. pit a small belt of limestone is encountered showing a thickness of about 75 feet which would be on the strike of the similar belt which crosses the Darling road a mile further west.

The Tommy R. Pit.—This working was full of water when examined. It consists of an irregular open cut extending about thirty feet along the outcropping of the ore-body and it is said carried to a depth of

* See Appendix A : No. 6.



For investigation Part I. Annual Report Vol. 1912-13

CALABOGIE MINES

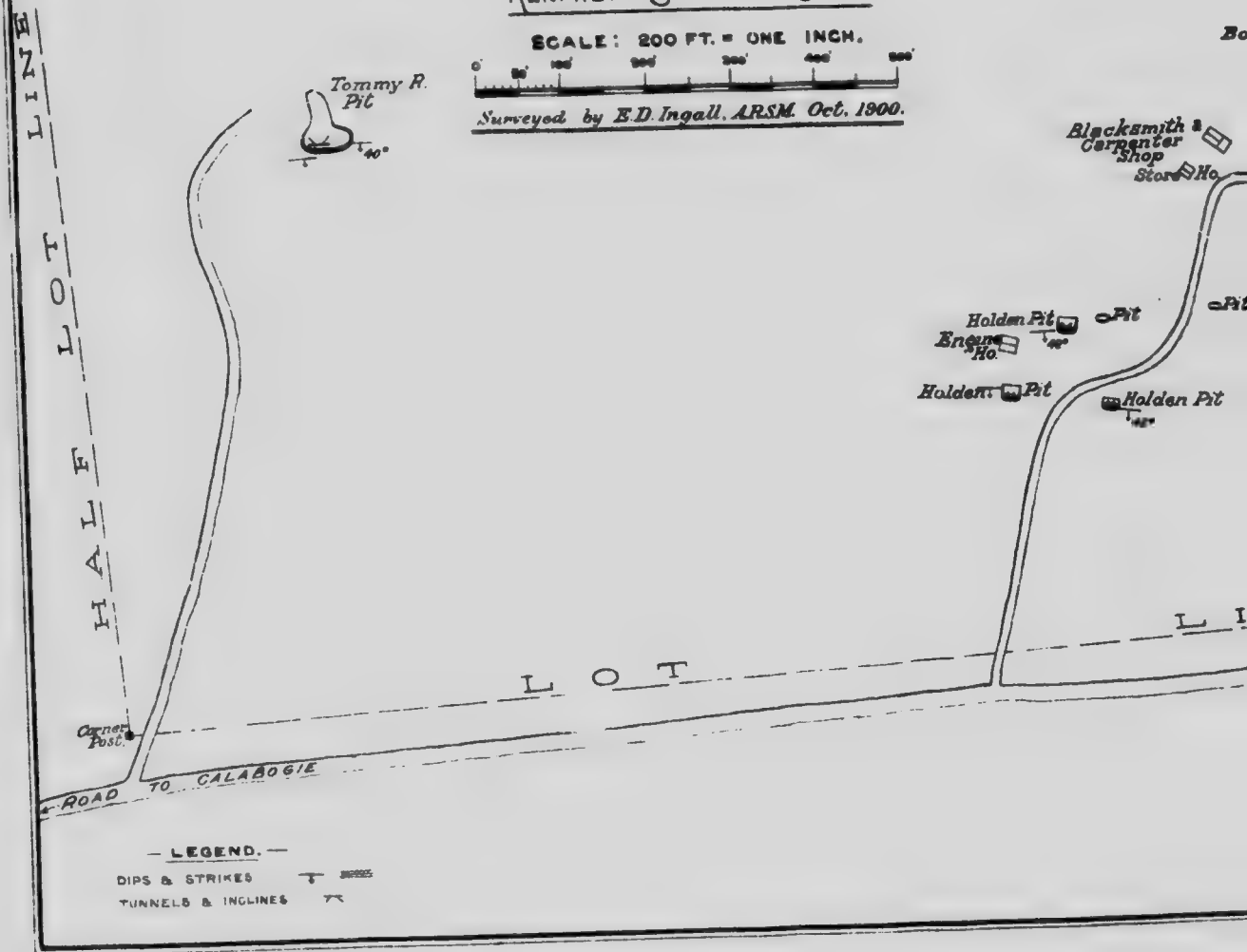
CAMPBELL & CALDWELL WORKINGS

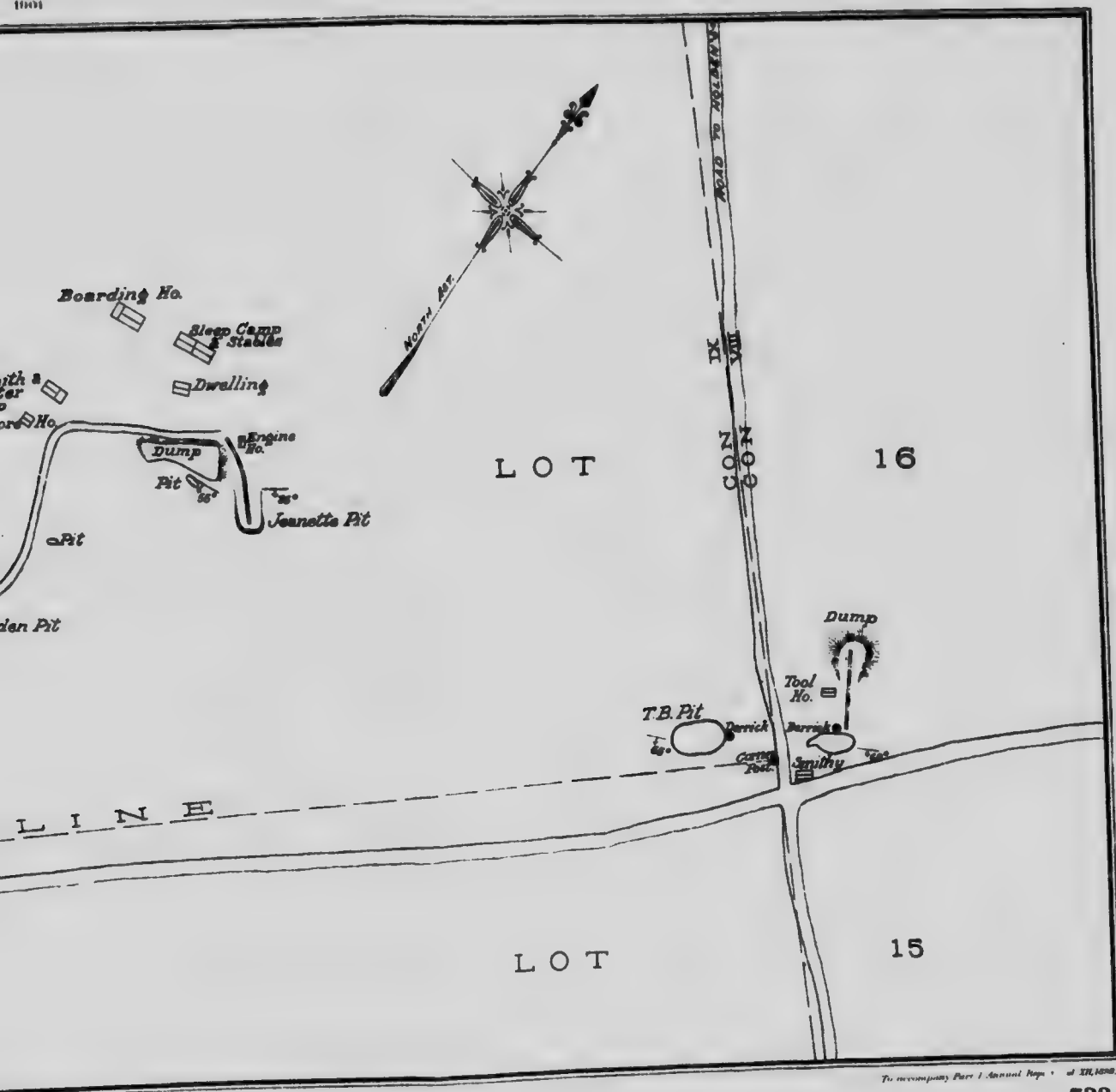
BAGOT TOWNSHIP

— RENFREW COUNTY, ONT. —

SCALE: 200 FT. = ONE INCH.

Surveyed by E.D. Ingall, ARSM. Oct. 1900.





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about thirty feet. The formation has a dip of about 40 degrees and Coe mine exhibits an occurrence of ore in amphibolite. At about 130 yards northwards, in a little bluff about twenty-five feet in height, the same basic rock is encountered, showing occasional lighter coloured ribs due to the greater preponderance of felspar, there being more mica and less hornblende in these portions. It is stated that a diamond drill hole was put down near this pit on the hanging wall side to a depth of eighty-four feet, the lower sixty-four feet being reported as through ore ground.

Holden Pits.—About 900 feet westerly from the Tommy R. pit there are three inclines. Two of these are sunk on the same run of ore and the third one on a parallel body about 80 feet north from these. The most westerly had, when visited, a length of about 20 feet on the strike of the body, a height of about eight feet and a depth of about thirty feet. The most easterly of these was slightly smaller. The northern one was very similar but the depth was not ascertainable however on account of water. Located between these and the Jeanette pit are several shallow workings on other ore outcroppings as shown on the plan.

The Jeanette Pit.—At this point an open cut sinking had been made on the dip of a magnetite body at an angle of about 35° which at the time the examination was made had attained a depth of about forty feet, the working so far having opened up a thickness of about eight feet of magnetite.

The T. B. Pit.—This is a large irregular open working about 70 feet by 40 feet and said to be sixty feet in depth though nearly full of water when visited. The upper portion showing above the water is very irregular, pockets of ore having been taken out all round wherever easily accessible. The inclosing rock is much more micaceous and more rotten than at the pits further west. Black mica probably biotite, in crystals about the size of the finger nail occurs associated with the ore-ribs which run through the rock. The work is not in such shape as to define the thickness of the ore-body at this point, but taking the width of the pit in conjunction with the dip of the formation, viz., S. 65° E. < 65°, a proved thickness at the surface of about 35 feet would be shown.

Ore Characteristics.—At the Tommy R. pit, a considerable amount of ore was piled up, probably from 800 to 900 tons. On examination it showed a fine parallel structure with interspersed particles of greenish rock matter and frequent interfoliated seams of the same which at

Coe mine.

places thicken out into small nodules. At the Jeanette pit a pile of over 800 tons of ore was examined when the first visit was made to the mine. It contained ore of good quality in large solid lumps, with a tendency to a platy structure and a slightly granular fracture across the grain. The intermixed material, estimated by eye at about five per cent, seemed to consist mostly of chlorite and calcite disseminated and in veinlets. Little or no pyrite was visible. At the T. B. pit the ore seemed to carry mica, chlorite and calcite as accessory minerals.

CAMPBELL MINE.

Bagot Township, Con. VIII., South half of Lot 16.

Campbell mine.

The workings known locally by this name are situated as shown on the plan immediately across the line from the T. B. pit of the last described property. The excavation made on the ore-body, was at the time of examination about 60 feet in length, and 30 feet in width with a depth of 55 feet. The bottom was not visible, however, as the pit was being cleaned up at the time. It is claimed that a thickness of 17 to 18 feet of ore was obtained in places. The formation dips here E.S.E. $< 60^\circ$. The inclosing rocks are dark, and somewhat schistose, carrying considerable mica and chlorite with harder tough hornblende ribs. According to the microscopic determination made, it can be classed as a plagioclase-scapolite-amphibolite. It was noticed here, as so often elsewhere, that the ore ribs frequently had chloritic selvages. Considerable ore has been shipped from this point.

Regarding this property, with the other as one ore-bearing area, it is evident on an examination of the plan, that the bodies of magnetite occur along several parallel ranges and the dip of the rocks gets steeper in going east. The features of the formation in which the ore-bodies occur have already been noted as far as the absence of limestone is concerned, although calcite, probably derived from the decomposition of some of the bi-silicate minerals of the rocks, is found in the ores. Judging from appearances on the ground, and from the microscopic examination made* it would seem as if the rocks inclosing the eastern bodies of ore on these properties show greater evidences of alteration than at points further west.

Magnetic Observations.—The cover of thick bush and the time at disposal for this point, allowed of only one long magnetic cross-section

* See Appendix A, Nos. 4 and 6.

and one short line being made. The latter shows only the attraction of the already known and worked ore-bodies at the Holden pits, the former, besides showing magnetic derangement for the T. B. and Campbell pits, shows the same for some distance either side of this point. The data are, however, entirely too limited to allow of any definite and final conclusions being drawn.

Campbell mine.

WILSON OR MARTEL MINE.

Bapt Township, Con. X., Lot 13.

South of the Bluff Point range of workings about a mile, is that known as the Martel or Wilson. The openings are two in number, in a flat of low ground, and being full of water to the top, and the soil covering extending all round, but little can be ascertained on the ground. One of the two pits is a mere prospect hole, said to be about 15 feet deep. The main pit is about 25 feet in diameter.

Wilson or Martel mine.

It is stated that the ore-body was 20 feet thick, and dipped about 60° to the S.E., and that about 2,000 tons of ore were extracted and shipped from this point. A small steam hoist and wire rope were used, so that the excavation must have been fairly deep.

The ore-body must have consisted of compact ore, as the waste dump is very small. The inclosing rock, judging from what little shows above water around the edge of the pit, and from the waste dump, is a compact, very fine-grained, and very black, hornblende rock, (diorite*) exhibiting on fracture, a bright, sparkling surface, and at a little distance off, it would be hard to distinguish it from the associated magnetite, so like are they in colour, texture, and general appearance. Throughout the rock are little, gash like areas, as well as larger ones, where the black hornblende is more largely and distinctly crystallized than in the mass of the rock, and where this process of segregation has resulted in a very coarse crystallization, quartz and cleavage masses of calcite are apt to occur, filling up the spaces between the hornblende crystals. Pyrite occurs not infrequently in the same connection. In many pieces of the rock magnetite was seen in seams and veinlets.

The ore, judging from what little yet remains scattered around, is compact and fine-grained, with a tendency to a platy structure. It is often streaked through with small seams of green chloritic material,

* See Appendix A., Specimen 15.

Wilson or
Martel mine.

and one or two pieces showed a little disseminated pyrite. It is said to have been very free from sulphur, which report is probably well founded, judging from the infrequency of its occurrence in what remains behind. It is said that about 1,000 tons of this ore was used at the Radnor furnace in Quebec.

Magnetic Readings.—A single preliminary line of dip-needle readings was taken at this point. These were extended in a northerly direction from the main pit for about 150 feet in which distance nothing very remarkable was noted. Going south from the same point, increases in the local magnetic attraction were observed at from 225 to 235 feet from the main pit and at a point about 550 feet measured from the same.

CULHANE MINE.

Bagot Township, Con. VII., N. 1-2 Lot 21.

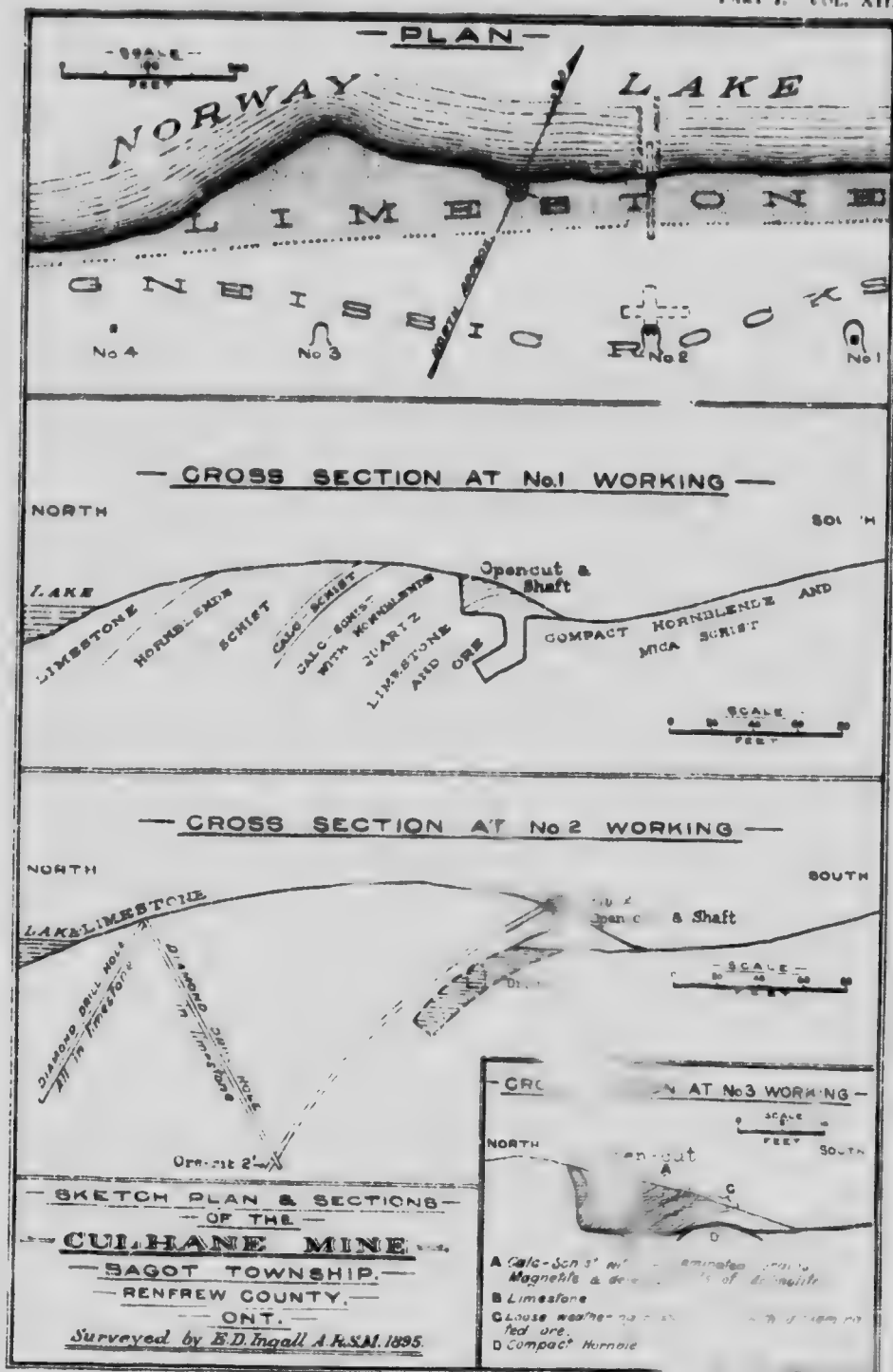
Culhane
mine.

This mine is situated on the south shore of Norway lake. The ore-body runs in a direction a little N. of E. and parallel to the shore, being distant from the same about 200 feet. Four openings have been made upon the ore-body, covering a length of about 900 feet. The mineral belt worked consists of hornblende, calcite and quartz, with plentiful grains of magnetite, etc., lying on compact hornblende and mica schist rocks which outcrop frequently in a southerly direction. In going north this magnetite bearing calc-schist is seen to be followed by a compact hornblende schist,* and this in turn by a band of crystalline limestone which forms the shore of the lake.

Point No. 1.—At this point is a small open cut about ten feet wide by thirty-five feet long, into the southern face of the little ridge which lies between the mine workings and the lake. From the bottom of this cut a small vertical shaft has been sunk to a depth of about fifteen feet, from the bottom of which the ore has been followed down northward on the slope for about twenty feet. The accompanying rough sketch shows the details of the ore-body and its inclosing rocks at this place. It is stated that no ore of any consequence was taken out here.

Point No. 2.—About 240 feet west of the last mentioned, lies the main shaft said to be seventy feet deep. It follows the dip of the rocks which on the surface is seen to be about 30° north, but it is said

* See Appendix A, specimen No. 7.



that below, the angle of dip was about 10° steeper. The features of the ore-body could only be examined for a short distance down from the surface on account of water. By picking up pieces of the shaft, however, the ore rib proved to be at least a foot thick, with some little intermixed rock matter, and a little pyrites was also recognized. In the ore are frequent joint planes parallel to the dip and where weathered, it is quite friable. Our guide who was foreman when the mine was working, stated that drifting had been done east and west from the shaft, at a depth of forty feet and that the west drift had a length of twenty-five feet, whilst the length of the east drift was forty feet. At the former the ore-body narrowed somewhat whilst in the latter it was of the same size. He further stated that the thickness of the ore in the bottom of the shaft was thirteen feet.

As far as could be seen above the water-line the hanging wall of the deposit is very distinct, the foot wall being however covered with debris. Above the rib of hard rock forming the hanging wall of the shaft or incline, is a thin ore rib of about two feet in thickness whilst above that again is the calc-schist. To the north, as shown in the sketch, some work was done with the diamond drill. One hole being, for some extraordinary reason, sunk northward and therefore, away from the ore, can be ignored. The other about at right angles to the dip of the ore-body only struck a three foot rib of ore which may represent the above described small ore-rib overlying the main body. The hole stopped in limestone but it does not seem to have been carried far enough to prove much.

Point No. 3.—About 400 feet west of No. 2, a small opening has been made, consisting of a little open cut about twenty-five feet long and six feet deep, the features of which are given in the accompanying illustration. As shown there seemed to be some little evidence of the existence of an anticlinal bend in the rocks at this point, although the working was in such a condition as to leave the question of the southerly dip somewhat doubtful.

Point No. 4.—This is the most westerly work done, being about 240 feet west of No. 3. It consists of a small test pit, the sides of which have so fallen in that it is difficult to see anything. It is stated, however, that it was sunk to a depth of about twelve feet, and that the last three feet was in ore, the body seeming to dip south. Having proved the existence of ore they stopped working. Immediately to the north of the pit compact hornblende-schist is seen to outcrop.

Ore Piles.—It is said that no ore was shipped from here, so that the ore piles now on the ground represent all that was extracted and

Culhane
mine.

from them a very good idea can be gained of the kind of material obtained. The pile at the main shaft, would contain about 715 tons of what has apparently been a schistose material with high percentage of magnetite grains, but which has now mostly crumbled to pieces from the action of the weather. At this spot pyrite appears to have been plentiful, existing as grains interspersed with those of the magnetite, as well as, occasionally in little veinlets crossing the structure of the ore. Calcite grains are also frequent. From an eye estimate it would seem that the calcite, pyrite, and other impurities, would amount to from twenty to twenty-five per cent of the ore. It was stated that the percentage of sulphur had lessened, as the deposit was followed downward. A few cubic feet of ore near Point No. 4 show much the same characteristics as that at the main shaft, except that it appears to be more compact.

WILLIAMS, OR BLACK BAY MINE.

Bagot Township Con. XI., Lot 22.

Williams or
Black Bay
mine.

This mine is situated about two miles north-west of Calabogie station on the Kingston and Pembroke railway.

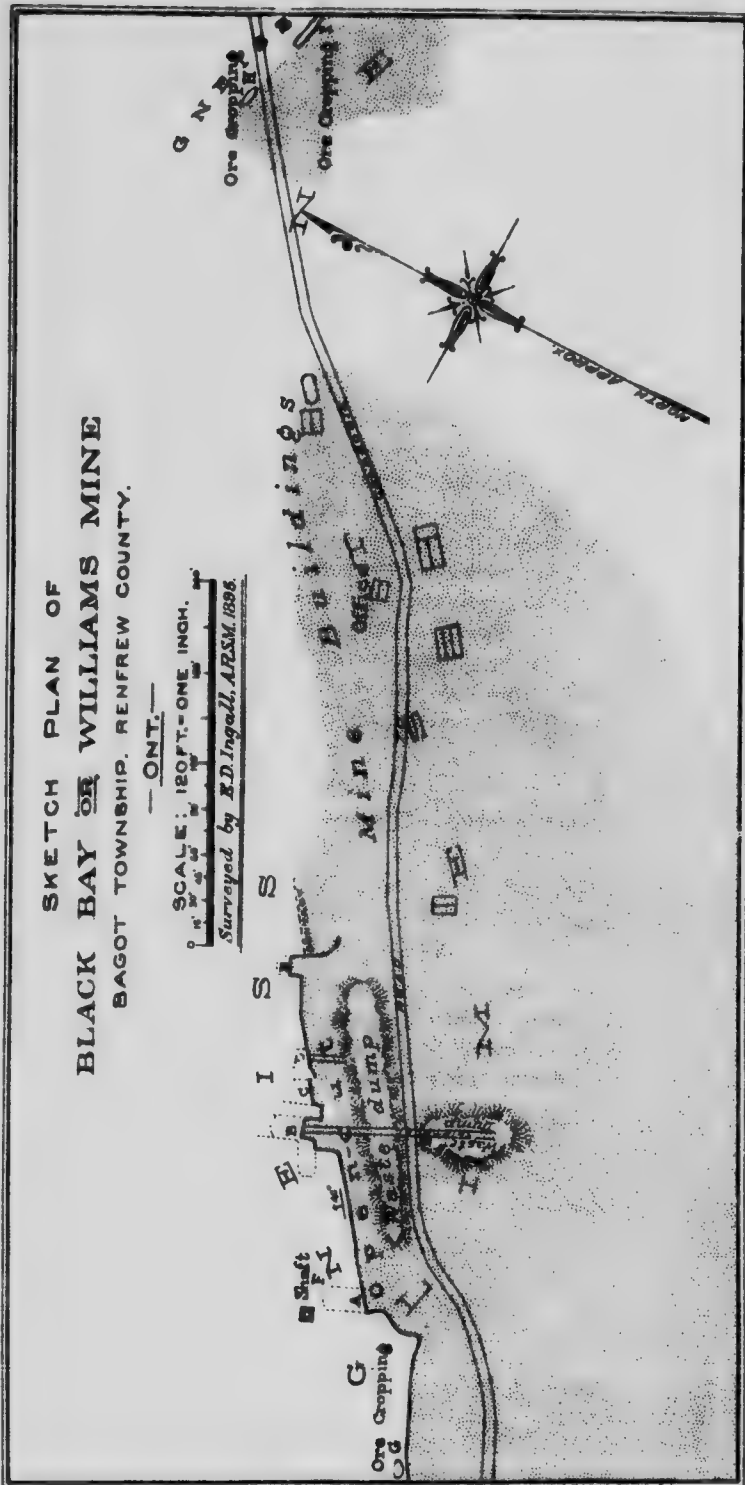
The rocks in the vicinity of the deposit consist of crystalline limestone, which forms its foot wall, overlain by a heavy basic (hornblendic) member of the series. This latter rock is very compact but on close examination shows a fine parallel or schistose structure.

The strike is about north-east and south-west with a dip judged by the inclination of the workings, of about 40° to the north, the limestone showing all around the south of the workings and forming the sloping floor of the open-cut. The basic overlying rock forms the surface for some distance north. The limestone is of the usual type found in the district, varying from white to grayish and coarsely crystalline in structure.

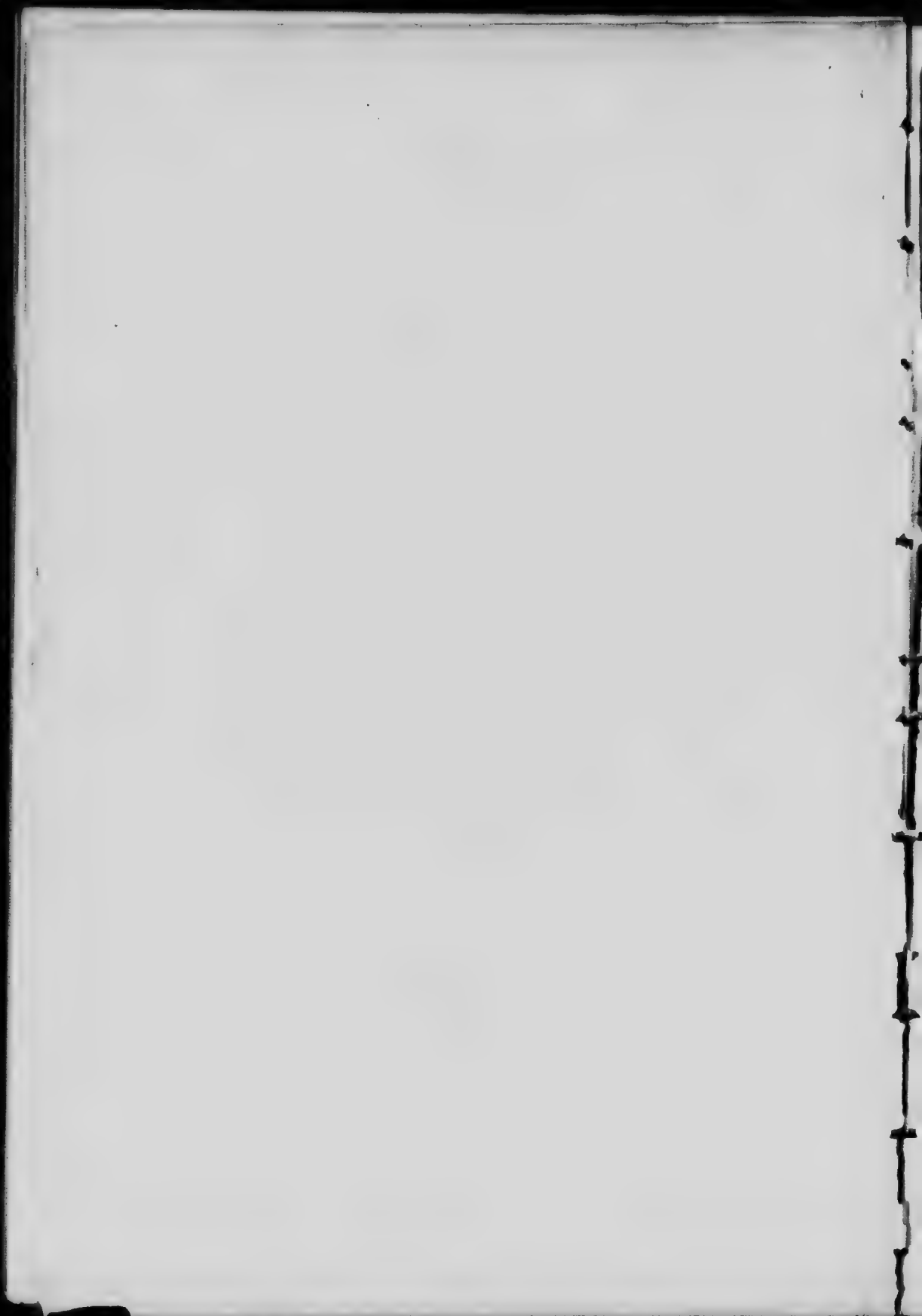
The proved length of the deposit in the main developments is about 240 feet, although as shown in the accompanying sketch plan, evidences of ore are shown in the small opening G about 100 feet further in a westerly direction and H and I about 600 feet in an easterly direction. The connection of these two latter with the main exposure is however not at all certain, no trace of ore having been found during the examination, in the stretch of rocky ground separating them from the open cut. In fact the ore-body appears to thin out and become indefinite at either end of the cut.

SKETCH PLAN OF
BLACK BAY OR WILLIAMS MINE
BAGOT TOWNSHIP, RENFREW COUNTY.

— ONT. —
SCALE: 120 FT. = ONE INCH.
Surveyed by E.D. Ingall, A.R.S.M. 1895.



Engraved by Miss Brewster



Opencut.—The main workings lettered A to E, were full of water, to within a short distance of the top, but they appeared to dip north-northward at an angle of about 40 degrees. The opencut has a face about fifteen feet in height, and beyond that the ore has been followed downward, in several inclines, as shown on the plan. Williams or Black Bay mine.

Point A is an incline sunk in the ore to a depth of about 25 feet. B and D are also inclines which are said to be about 80 feet deep, and to be chambered out below and connected with each other. C and E are only shallow inclines, the former about 25 feet and the latter about 10 feet deep.

An examination of the part of the deposit above the water-level, seems to show that the workable thickness of the ore was variable, and probably interrupted by portions of barren rock or lean ore, the magnetite occurring in basic hornblende gneiss. About the openings of the main workings in the middle of the opencut, the thickness of the ore would appear to have been about 10 feet, but towards the ends it seems to have thinned out and become indefinite, the ore ground being represented by rock containing disseminated magnetite. It is stated that in the underground workings the ore-body measured in places about 20 feet across, but admitted that it varied in thickness. Where ore occurs in the limestone it is mostly in ribs paralleling the structure of that rock.

Point F.—This is a small prospect shaft sunk vertically in the hanging wall rock to a depth of about 22 feet and judging from the material thrown out, did not reach the ore-body.

Point G.—A little ore or magnetite-bearing part of the hanging wall rock, has been exposed by a shot or two. Crystalline limestone, shows in contact with the same, at one corner of the pit.

Point H.—An outcropping of ore about four feet across with the basic gneissic rock above, and the crystalline limestone below. It has a rather scoriaceous appearance, due evidently to the ore being somewhat calcareous and having been weathered to a slight depth.

Point I.—Is a very similar occurrence to the last. An exposure about fifty feet in length and about four feet thick is shown. The ore appears to be rather lean and lies very flat between the gneissic hanging wall and crystalline limestone foot wall rocks as elsewhere. A few shots have been put in.

**Ore Characteristics.*—There is no large pile of ore at this place from which to judge the characteristics of the shipping ore. Some of

* See Appendix A, Specimen No. 1.

Williams or
Black Bay
mine.

the specimens obtained show considerable intermixture of grains of calcite, some of which weathers brown, and is doubtless a ferruginous dolomite, judging from its slow effervescence with acid. Where the ore occurs in the hornblendic rocks it is much harder and would contain considerable admixed bi-silicates and possibly quartz in places. In the out-crop of the deposit some pyrite was seen but it seemed to be mostly concentrated by itself in seams, etc.

Cost of Mining.—It is said that ore mined and shipped from this point to Cleveland, Ohio, cost, laid down there, \$4.25 per ton.

Magnetic Readings.—Dip needle readings were taken along four lines at right angles to the strike of the ore-body with only negative results. The particulars were as follow :—Line No. 1—250 feet east of point E. to a point about 300 feet south of the line of strike of the ore-body to an equal distance north of the same. Line No. 2.—From a point 150 feet south of point E to a point about 200 feet north of the same. Line No. 4.—Commencing at opening G and extending northwards for about 350 feet. In the first and last readings were taken every twenty paces and in the second every ten. In none was any particular attraction noticeable in the distance traversed. Line No. 3.—Commenced 200 feet south of point A and was extended northwards past the same a distance of about 350 feet. No attraction was found until A was reached. At that place a fairly heavy downpull was noted which gradually decreased until at about 150 feet past this point the needle had returned to normal.

CHAFFEY AND MATTHEWS MINES.

S. Crosby Township, Con. VI., Lot 27 ; N. Crosby, Con. VI., Lot 1.

Chaffey and
Matthews
mines.

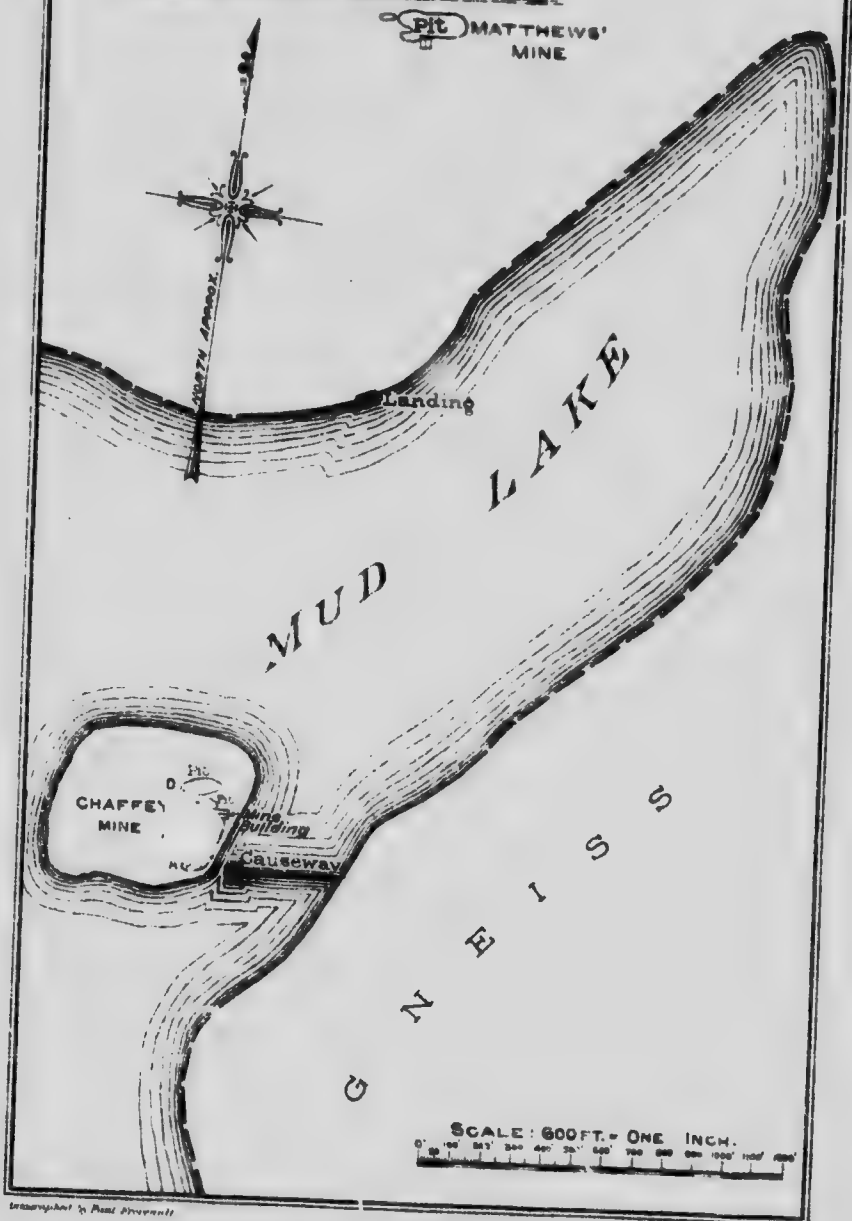
These two mines are situated near each other, and within a mile and a half west of the village of Newboro' on the Rideau canal, between Upper Rideau lake and Mud lake.

The Chaffey mine is situated on a small island but a short distance from the north shore of Mud lake and the Matthews mine about half a mile northward of that point, on the main shore. It will be thus seen that they are exceptionally well situated as regards shipping facilities. Not only does the canal give water communication with the United States and points in Canada, but the Sault Ste. Marie, Westport and Brockville railway passing close by, gives connection with the main trunk lines of the country.

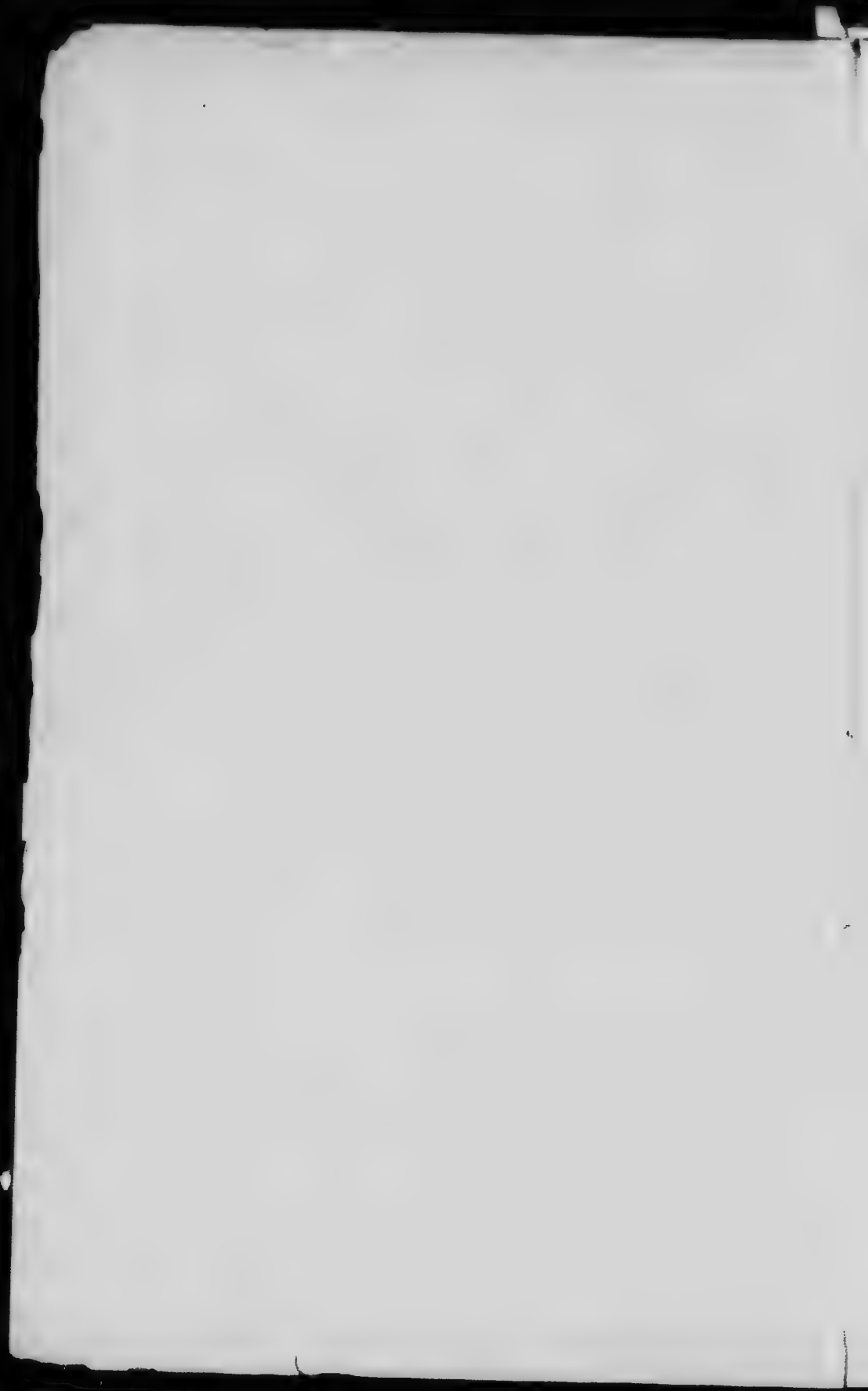
CHAFFEY & MATTHEWS — MINES —

CROSBY TOWNSHIP,
LEEDS COUNTY, ONT.

Surveyed by E.D. Ingham A.B.C.M. — 1895-1900.



Reproduced in Part II, p. 111



The geological conditions under which these deposits occur are so similar, that they are best considered together. They seem to represent a number of large but irregular aggregations of magnetite in a coarse grained basic rock probably gabbro. The irregularity of their shape and their relative position with regard to each other, is apparent on examining the accompanying plan. The parallelism of the longer diameters of pits with each other will be noticeable. This direction is also conformable to the general strike of the formation in this district.

Chaffey and
Matthews
mines.

At the Chaffey mine are three large irregular shaped pits, their longer diameters roughly parallel to each other and very close to the east shore of the island. They are separated from each other by walls of barren rock, and have apparently been worked on isolated ore-bodies. In length the three main pits would average about 150 feet and in width about 50 feet at the surface. They were at the time of our visit full of water to the level of the lake, although the walls stand up some 15 to 20 feet above that level. These three pits are said to have an average depth of about 50 feet. Between the two most northerly pits is a small pit said to be but 15 feet deep, and measuring about 40 by 20 feet. These constitute the whole of the workings with the exception of one or two little prospect pits in other parts of the island, which do not seem to have proved any other ore-bodies. As the island itself measures only about 400 by 600 feet, there would not be room for very extensive workings.

Magnetic Readings.—A couple of preliminary lines of readings were taken with the dip-needle, one about north and south, passing the western ends of the pits, and the other in a westerly direction from the west end of pit A. Strong attraction was shown all along the first mentioned, especially between the northern shore of the island and the end of pit D (70 to 85 degrees dip) a slight lessening is recorded from this point to end of pit A (50 to 60 degrees dip) and still greater lessening south from this point, to the southern shore of the island (30 to 53 degrees dip). Along the second line the attraction is much lighter, the reading varying between 20 and 30 degrees, with the exception of one reading of 50 degrees near the pit. The workings at the Matthews mine consist of one large pit with an extreme length of about 300 feet, and width of about 100 feet. According to Mr. Vennor it had attained a depth of 40 feet in 1871. It is full of water almost to the top, and but little can be seen. A gneissic structure is noticeable in the rock at places around the edge of this pit, the strike shown being about E. N. E. and the dip steeply to the north.

Chaffey and
Matthews
mines.

Magnetic Readings.—Two lines of dip needle readings were taken, one across the longer diameter of the pit, for a distance of about 750 feet northerly, and about 1,200 feet southerly, and one along that direction for a distance of about 350 feet easterly and about 650 feet westerly. Comparatively strong average attraction is shown along all these lines. The readings on the line to the eastward vary between 65 and 75 degrees with a slight lessening at places to from 50 to 65 degrees. Passing westward from the end of the pit for about 100 feet, the needle reads from 70 to 80 degrees, then for about 400 feet the variation is between 35 and 45 degrees, lessening to 30 at the extreme western end of the series of observations. The attraction along the line passing south from the pit varies from 30 to 50 degrees, with a few occasional lessening at places to 30 degrees. Passing northward from the pit for the first 150 feet the readings vary from 50 to 75 degrees, for the next 200 feet they average from 35 to 45 degrees; for 250 feet more the attraction increases and the readings range between 45 and 55 degrees, lessening again to 30 to 40 degrees at the northern end of the line. To really throw light upon the question of the direction and extent of the extension of the ore-bodies at both of these mines, a much more complete magnetic survey would be required, but as far as they go, the observations would seem to be such as would result from the variation in the quantity of magnetite at different points in a mass of basic rock.

As far as the examination could be carried in the limited time at disposal, there seems to be no reason to conclude that the Chaffey and Matthews pits are on the same bed, which seems to have been the idea entertained by the early operators. On the contrary they seem to represent detached, irregular bodies of magnetite, or local concentrations of that mineral constituent, of a basic igneous rock.

History.—In the Geology of Canada, 1863, the Chaffey mine is mentioned as working in 1858 and 1859, during which period about 6000 tons of ore were mined and shipped to Pittsburg, by way of the Rideau canal and Kingston. Writing later, Mr. Vennor, in the Geological Reports states that in 1871, some twelve men were employed, and 3,500 tons of ore mined and sold. The ore was shipped to Cleveland, Ohio via Kingston. At the mine the ore was said to be worth \$2.25 per ton, and delivered at Cleveland it brought \$6.00 to \$6.50 per ton, and the cost of carriage to Kingston was 75 cents per ton.

In the Report of Progress of the Geological Survey for 1871-2, Mr. Vennor gives the following particulars regarding the Matthews mine.

It had been more or less worked since 1860. During 1871, fifteen men were steadily employed, and upwards of 4,000 tons of ore raised, 3,300 tons of which were sold and shipped to Cleveland, Ohio via Kingston. The same prices were realized as for the Chaffey ore. The total amount of ore sold and shipped to Cleveland from these two mines for the years 1870 and 1871 combined, amounted to 14,520 tons.

Chaffey and
Matthews
mines.

HÆMATITE.

Apart from the study of the above described magnetite deposits, visits were made to a number of points where it was reported that there were occurrences of hematite bodies or indications of the same.

Hematite:—
Mode of
occurrence.

At one point only had any considerable development been done, viz., at the Playfair or Dalhousie mine, in the township of Dalhousie, Lanark county. At all the other points the reported occurrences were based upon the existence of certain alleged surface indications which had led in some instances to the opening of a few shallow test pits. In some instances the presence of iron ore was suspected on account of the ochreous stained soil and the ploughing up of pieces of iron stained rock. Some of these were found to be merely pieces of sandstone charged with iron oxide to a greater or less extent, the colours varying from yellow ochre to dark red. Along with these, occasional heavier pieces were found containing the iron oxide in larger percentage and more consolidated condition. Some even might be classed as good ore shewing a blue-black compact fracture and all the appearance of hematite.

Hematitic ore was also seen occurring in the basal beds of the Palæozoic series with outliers of which all these indications seem to be associated. It was seen also at a few places filling "gash" fissures in the underlying crystalline limestone of the Archæan at these points.

From the series of observations made, the impression was left that the ore at these places represented merely casual aggregations of iron peroxide probably resulting from the decomposition of the ferruginous dolomitic portions of the above mentioned sedimentary series. They would represent all conditions, from mere ochreous staining of the siliceous parts of the rock through more highly feriferous sandstones, to masses of loose ochreous material and hematite proper according to the extent to which consolidation had proceeded. In places the ochreous decomposition product had leached downward into water-worn cavities and channels in the crystalline limestone wherever this

Hæmatite
Made of
crystalline iron

happens to be the rock on which the overlying sedimentary beds rest. Wherever these cavities have been large and the overlying rocks highly ferriferous one can understand the possibility of the formation of just such a body of ore as that worked at the Dalhousie mine.

The presence of iron in these basal beds as oxide in various forms both in the arenaceous and dolomitic portions was pointed out in the *Geology of Canada* (1863) where these rocks were described.

They consist of a series of sandstones, etc., of various colors lying on the denuded surface of the Archaean rocks and forming the lowest beds of the Cambro-Silurian formation. Towards the base they are apt to contain pebbles, sometimes scattered throughout the rock and sometimes in beds. At the very base, is generally a conglomerate made up of similar pebbles. These consist of material, chiefly quartzite, probably derived from the Archaean rocks on which they lie.

The edge of the main area of these rocks lies to the south of the district under description, but numerous outliers are found northward from this. It is possible that some of the more northerly of the ferruginous occurrences noted should be credited to the Calciferous, with its largely developed dolomitic constituents. In this connection it is to be noted that fossils referred by Dr. Ami, of the Survey, to the Calciferous were obtained from near Flower station on the Kingston and Pembroke railway in Lavant township.

The details regarding the various points are given below :

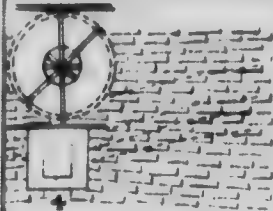
PLAYFAIR OR DALHOUSIE MINE.

Lanark County, Dalhousie Township, Con. 4, Lot 1.

Playfair or
Dalhousie
mine.

The only developments of any extent on hæmatite ore in this district were those made at the Playfair mine about thirty years ago, several thousand tons of ore were taken from this point and sent to the United States. From the descriptions available the hæmatite shipped seems to have been of good quality.

Here the conditions are apparently somewhat different from those at any of the points subsequently described. A body of hæmatite was found inclosed in the crystalline limestone of the Archaen which is seen to outcrop frequently for some little distance around the workings. There are none of the sedimentary rocks visible in the immediate



NOTE: The figures in the Longitudinal Section refer to the thickness of the ore-deposit at the various points given.



PLAYFAIR & DALHOUSIE

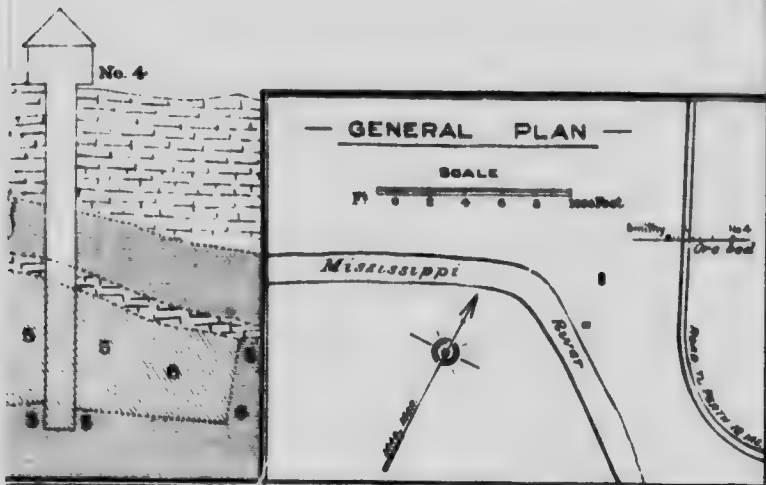
— MINE —

— LANARK COUNTY —

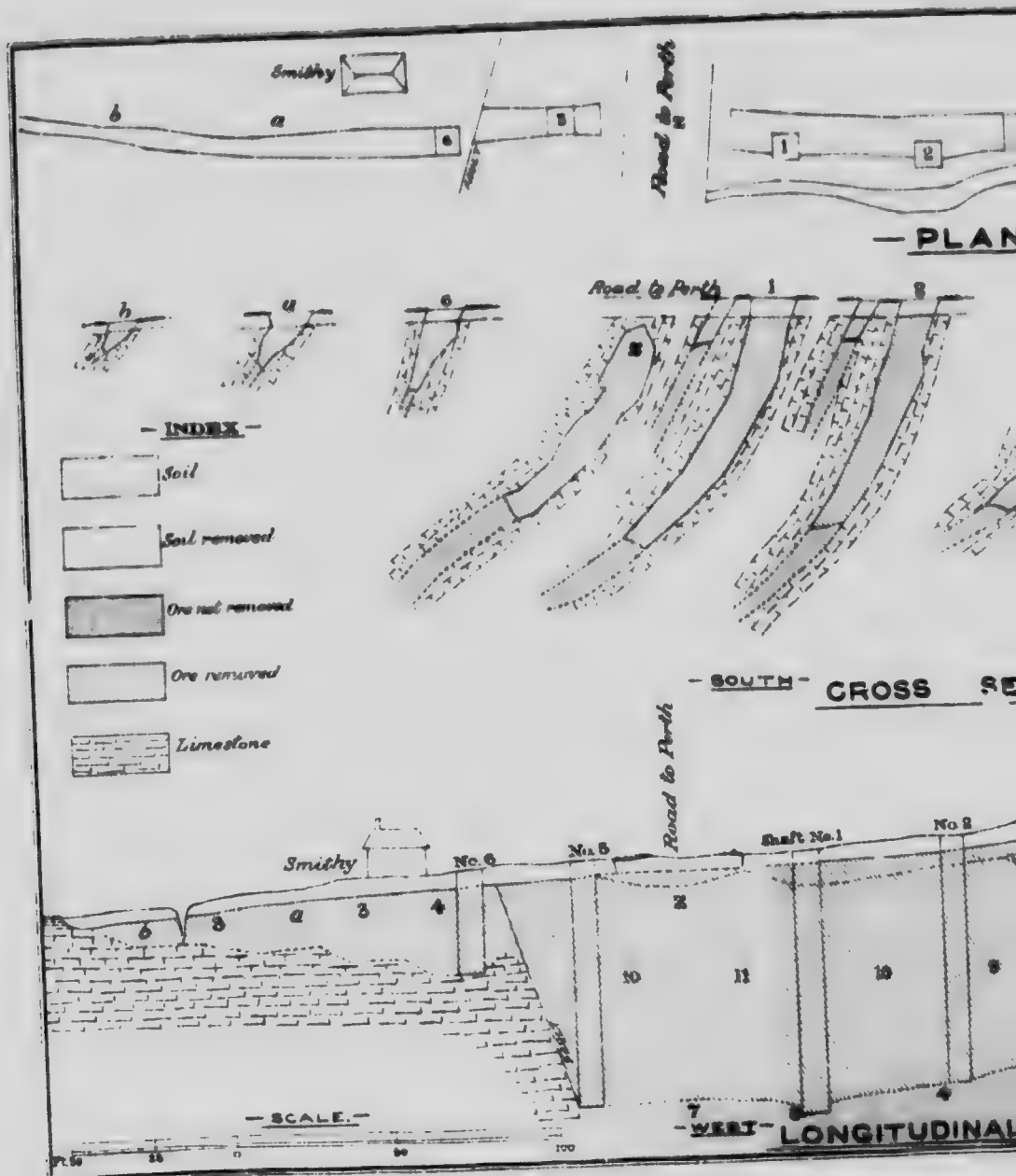
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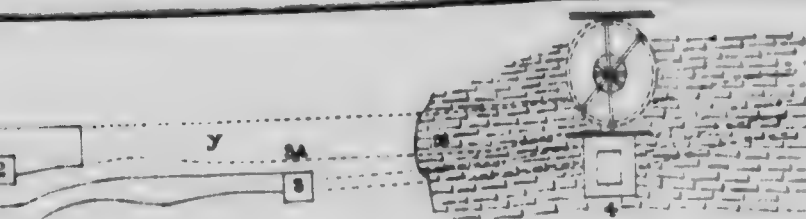
— From Plan of Gerald C. Brown. —

— Perth, 18th July 1873. —



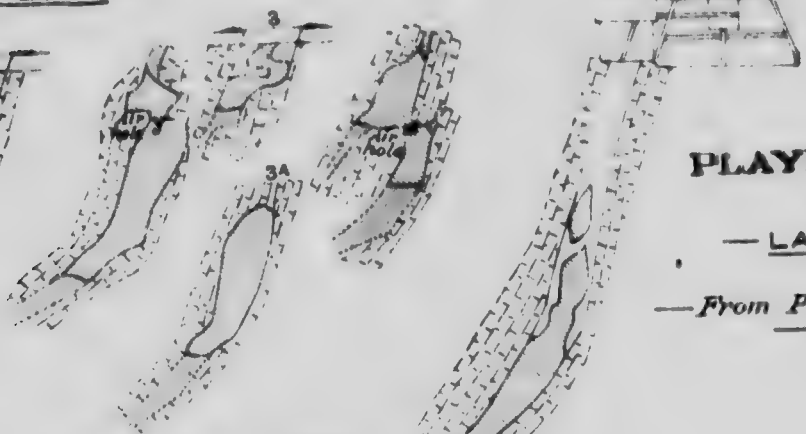
The accompanying Part I. Annual Report Vol. III, 1890





NOTE: The figures in the Longitudinal Section refer to the thickness of the ore-deposit at the various points given.

PLAN—



PLAYFAIR & DALHOUSIE

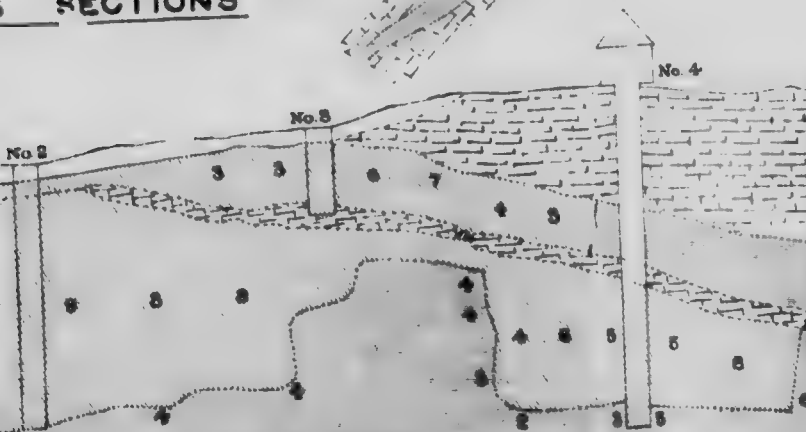
— MINE —

— LANARK COUNTY —

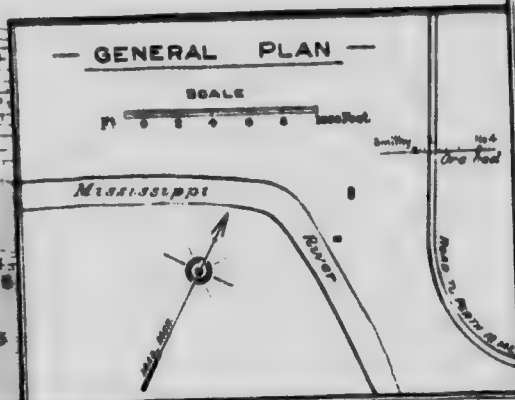
— ONT. —

— From Plan of Gerald C. Brown, —
— Perth, 18th July 1873. —

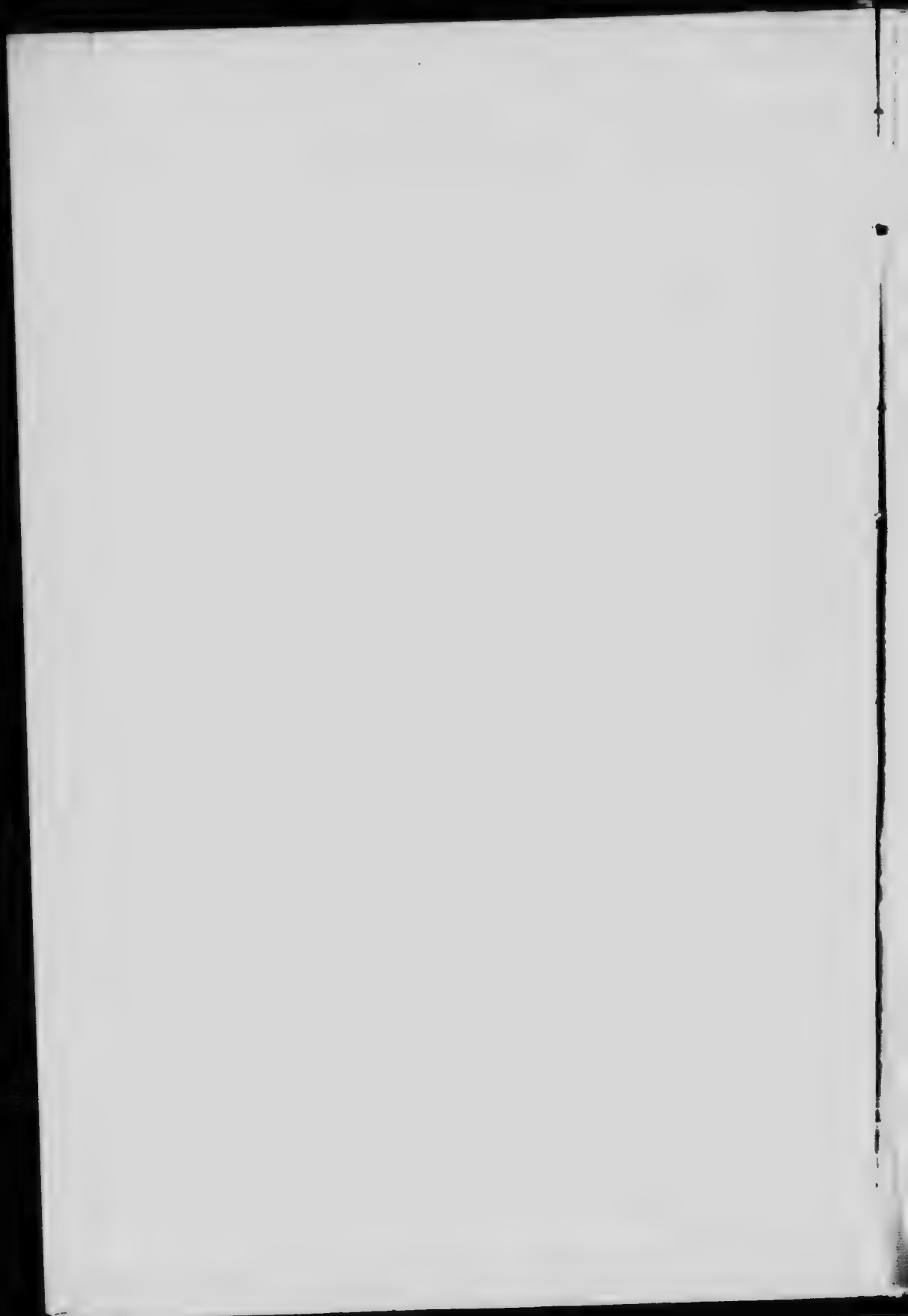
SECTIONS — NORTH —



DINAL SECTION — EAST —



To accompany Part I. Annual Report Vol. XL, 1880



vicinity of the old workings, although those subsequently described as near Playfairs Mills are only about one mile to the south and there seems to be some evidence of similar occurrences along the north bank of the Mississippi river, to the westward of the mine. Playfair or
Dalhousie
mine.

The accompanying plan of the workings at this point has been reproduced from the Report of Progress of the Geological Survey of Canada for 1872-3 as it illustrates a number of important features presented by the deposit.* Mr. Vennor in the reports of the survey for 1871-2 and 1872-3 makes mention of the deposit, but beyond speaking of it as a bed of red hematite gives no details as to its mode of occurrence.

Dr. Harrington in his notes on the "Iron ores of Canada" published in the Report of Progress of the Geological Survey of Canada 1873-4 gives the following further details. "At one point in the workings, a soft chloritic looking slate with numerous crystals of pyrites, seems to intervene between the ore and the underlying limestone. The limestone is highly crystalline; that underlying the main deposit being white and containing large quantities of tremolite, while that which overlies it is stained red with peroxide of iron. When the mine was opened up there appeared to be two beds cropping out in places at the surface with four or five feet of limestone between them. The uppermost and smaller of these was found to run out at a few feet in depth, and to extend but a short distance in the direction of the strike. The larger deposit was in places as much as nine feet thick at the surface, and at a depth of eighty feet had an average thickness of four or five feet."

In studying the deposit for the purpose of this report the main features illustrated in the plan given herewith were corroborated and some later surface exploratory workings were studied. The old workings were mostly caved in, so that the excavation could only be followed down a few feet, but sufficient could there be seen together with the study of the surface phenomena and the facts revealed by the plans to arrive at a judgment as to the nature of the deposit and its relation to the hematitic croppings of other places in the district.

It appears to have been a lense-shape body of hematite which showed a tendency to thin out both in length and depth. The whole length of the excavation made was about 500 feet and for about half the distance

* In reproducing this illustration in the report of the Ontario Mineral Commission, p. 139 figures 21 and 22, the scale as here reduced has been erroneously given as 660 feet to the inch instead of 200 feet as it should be which makes the length of the vein developed appear much longer than it really is.

Playfair or
Dalhousie
mine.

at the eastern end the main body was paralleled by a smaller one, the two being separated by a wall of limestone about 5 to 10 feet in thickness. The greatest thickness of the smaller lense was about seven feet and it seems to have thinned out to nothing both in length and depth. The plans show that in working the main ore-body a similar narrowing was observable in depth and also in passing west, in which direction it would seem to have thinned out to practically nothing. The evidence of the existence of a fault shown between pits Nos. 5 and 6 was not very plain on the ground. Going eastwards a curious feature is noted, viz., that the ore-body did not reach the surface after passing the point "X" on the plan, so that for some fifty feet before arriving at the last shaft (No. 4) the crystalline limestone occupied the surface unbroken by any outcropping of ore. This was corroborated by a careful examination of the ground for several hundred feet to the east of point "X." No signs of ore were found and, the rock exposures being prominent and frequent, the limestone could be traced practically continuously right across the line where the ore outcrop should show and for some distance on either side of it. The operators had evidently also tried to find the outcrop in this direction having driven a long cross trench about 100 feet east of No. 4 shaft in which, however, they had got no trace of ore. Mr. Vennor, in one of his reports, mentions the fact that the ore contains no rock and does not pass into but separates easily from the walls, which are smooth and well defined.

The strike of the ore-body, about E.N.E., and the dip about 60 to 70 degrees southerly conform to the general strike and dip of the rock formation in this vicinity.

In the light of the observations made at this point and of numerous other occurrences of hematite in connection with the outliers of the sedimentary series in other parts of the district it would seem that the ore-body at this mine probably owed its existence to similar causes. The peculiar features could be accounted for by regarding it as the result of an infilling of a cavity in the limestone worn out by water along the structural planes of the rock, and filled in from above by such material as is elsewhere found to result from the decomposition of the ferruginous dolomitic portions of the overlying sedimentary beds. That these were once continuous over the whole of this section of the country is apparent, and as before stated, some remains of these beds are yet visible about two miles to the south at Playfairville, where, as already described, they are impregnated with ochreous decomposition products.

It is said that the ore was soft on the top and got harder in depth, shewing a varying degree of consolidation, and a similar infilling of small fissures or cavities in the crystalline limestone was noted at several other places so that taking the smooth walls and all the other features into account, it would seem that this was merely a similar occurrence, only on a much larger scale.

Playfair or
Dalhousie
mine.

Passing westerly along the strike of the ore-body a couple of small test pits were found. The first, about 100 yards from shaft No. 6, on the plan, was full of water to within about 12 feet of the surface, but a few features could be noted in the portion showing. The eastern end showed a few irregular seams of hæmatite a few inches in thickness embedded in a kind of calc-schist, with limestone hanging wall. The foot-wall side of the pit was covered with debris. About twenty-five yards still further west was a small and shallow incline about 15 feet in depth, dipping at an angle of about 25 degrees to the southward. At the eastern end a rusty rib showed, due evidently to the decomposition of pyrite which is here plentiful. Some of the material showed a peculiar fine honeycombed structure, grains of pyrite having been weathered out from a reticulation of quartz. Similar material was found about one quarter of a mile further west in the workings below described.

For a distance of nearly half a mile west of the last mentioned, along the north bank of the Mississippi river, an attempt had evidently been made to trace the ore-body. Several cross trenches and shallow test pits had been made, in which some hæmatitic and ochreous material was obtained, but in most cases it did not seem very certain whether it had been in the solid or was just float ore. At one place a small pile of a few cubic feet of lumps of good ore had resulted, and pieces of float ore, often of good quality, were to be seen on the hill-side and river shore, but the whole probably represents material left the remnants of previously existent sedimentary rocks.

As all the ore had been removed from around the main workings there was no means of comparing it, in regard to structural details, etc., with other hæmatitic material from this district. Judging from the small amount of waste material the ore must have been very free from admixture. The composition of the ore is illustrated by the analysis given in the table at the end of the report. It will be noticed that there is no determination of the sulphur, although pyrite was noted in places in the deposit. It is reported that the ore was practically free from sulphur. On this point, however, no very authentic data are available.

Mr. Vennor's report gives the ore shipments from 1870 to 1873 as 11,100 tons. According to the same authority, the mine was first opened in 1866.

DALHOUSIE LAKE.

Lanark County.

Dalhousie
lake.

Another locality where hæmatite was reported to occur was at the west end of Dalhousie lake in the township of that name. It was found that pieces of hæmatitic and ochreous sandstone had been ploughed up on the farm on the E- $\frac{1}{2}$ of lot 11 in concession XII., and an exposure of the sandstone was seen on the west shore of the lake on the W. $\frac{1}{2}$ of lot 11 in concession XI. At the latter place a little picking had been done and the rock was very loose grained, friable and highly charged with soft red ochreous oxide.

BATHURST TOWNSHIP.

Lanark County.

Bathurst
township.

Indications of the occurrences of hæmatite were reported from this place on lots 22 and 23 in concession X. and 21 in concession XI. They were found to consist of a rusty outcropping on the north bank of Bolton brook near where the road crosses it, some lumps of material varying between ochreous sandstone and solid hæmatite ploughed up in a field on Gallagher's farm and similar material obtained in digging a well on Bain's farm near the house. The occurrences present similar features to those in Portland, etc., hereafter described, the sedimentary rocks being in this case represented in a little quarry of white sandstone near Bain's house. A few pieces of rock which had been extracted from a little pit near the same place showed some solid dark hæmatite in crystalline limestone and it was said that a narrow vein of the ore a few inches thick had been exposed in the workings. It probably represented as elsewhere a small "gash" vein in the Archæan rocks filled in with hæmatitic material from the palæozoic rocks formerly overlying the spot.

About two miles north of Fallbrook, at Playfairs Mills similar conditions are found. A short distance to the south of the saw-mill are several shallow test pits in which is to be seen much ochery matter varying from a hæmatitic or compact ochreous material through intermediate grades of similar materials with sandstone grains and others in which glassy quartz grains shew, to grey sandstone with ochreous

stained areas and unaltered cores some of which are dolomitic as shown by their more crystalline fracture and slow effervescence with acid. Bethurst Township.

The rocks of the immediate vicinity consist of the sandstone lying upon Archean crystalline limestone.

At points visited in the south-west part of this township conditions were observed very similar to those last described. The ferruginous matter seen, however, was more in the ochrey condition impregnating the rocks, but little of it having been consolidated into the form of hematite.

On lot 2, concession IV., were two small and shallow pits which had evidently been sunk on ochreous matter which had collected and become partly consolidated in joints, etc., in the rocks. In one case the appearance presented was that of a vugg in the crystalline limestone filled in as above suggested.

On the eastern half of lot 3, concession IV., some shallow workings were seen where ochreous stain in the rocks was visible. One pit about ten feet deep had been sunk in what appeared to be a red, ochreous, sandstone. Several other shallow workings had been made in the same material within a radius of about 150 feet. All around rise bosses of crystalline limestone, while to the south white sandstone is to be seen lying in a hollow of the limestone. The whole is evidently an outlier of the palaeozoic formation carrying in places much dolomite as evidenced by the slow effervescence with acid. This being ferruginous seems to be the source from which is derived the pseudo-hematite material which is found filling the jointing of the rocks at the points worked and mostly staining the pieces throughout. Specimens were observed apparently consisting almost altogether of ferruginous dolomite, presenting an ochreous envelope, evidently due to decomposition, and enclosing a core of the unaltered grey rock.

An interesting feature observed in the vicinity of these areas of ferruginous sedimentary rocks consisted in a tongue or small vein of somewhat similar material filling a small irregular crack or gash vein in the subjacent crystalline limestone. It varied from a mere iron-stained crack up to a width of a few inches. The filling was at places somewhat friable iron-stained material, at others it resembled white sandstone. It left the impression of having been a previously existing crack which had been filled in with some of the sedimentary material.

BEDFORD TOWNSHIP.

*Frontenac County.*Bedford
township.

On the north shore of Birch lake, on the property owned by Mr. J. Bawden, of Kingston, is another occurrence on which a little work has been done. The hematite and hematitic ore seems in a general way to occur similarly to those already described. The local conditions are such, however, that nothing very definite could be made out in the short time at disposal when the place was visited. Some of the lumps of good hematite brought away shew a curious admixture of small crystals of pale mica. Besides this more compact ore the oxide of iron occurs, also in the softer ochreous forms.

STORRINGTON TOWNSHIP.

*Frontenac County.*Storrington
township.

On lot 20, concession X., a most interesting development is found occupying the neck of land which divides Dog lake from Cranes Nest lake to the north of it.

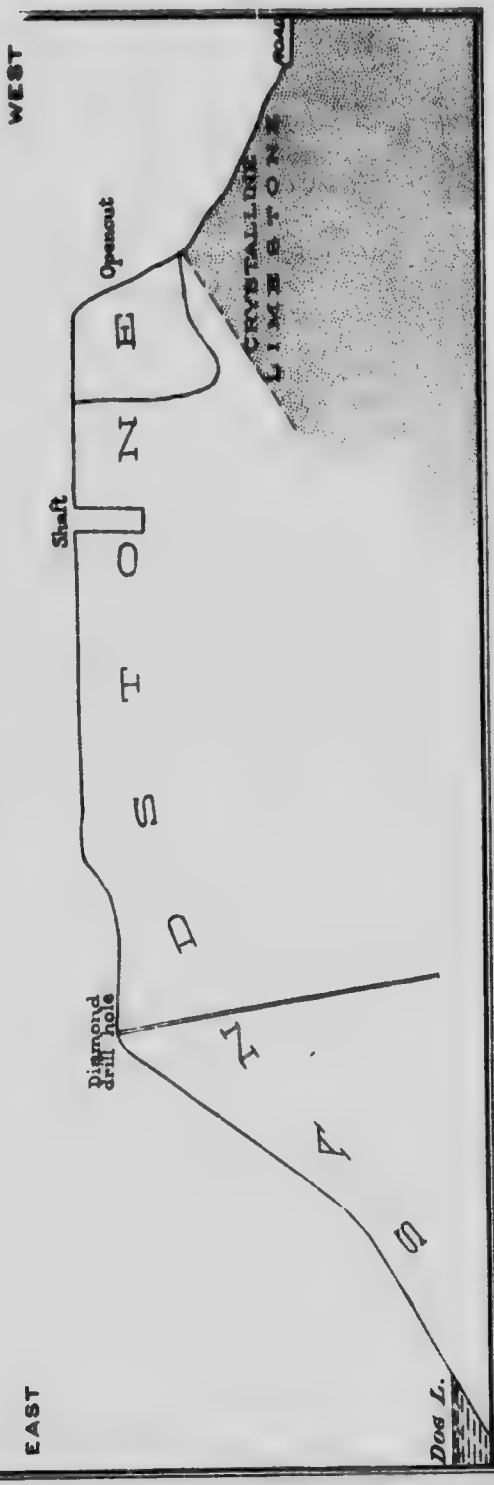
The ridge of rock occupying this neck is about 100 feet in height above the lake and consists of red sandstone lying on Archean rocks represented by crystalline limestones which can there be seen close up to and passing under the sandstone. The former as seen in the cliff faces of the ridge shows considerable evidence of false bedding. It carries pebbles of varying size, irregularly distributed, sometimes occurring singly and scattered at others in locally limited layers. A compact weather-resisting glaciated layer forms the top of the ridge, and exhibits some interesting samples of pot holes.

The rock seems to weather very variably, some surfaces being but little affected whilst at other points much corrosion has taken place which has often resulted in the formation of small caverns. These, at places, have for a roof the underside of a layer of pebbles.

It was noted here, as elsewhere that the ore parts seemed to be connected with these easily corroded portions and to be due to the local impregnation of the rock with peroxide of iron in ochreous form as well as occasionally in the more consolidated condition of hematite. As in the other cases described, the exposures at this place left the impression that the ferruginous matter had been most likely derived

SKETCH OF SECTION
DOG LAKE HÆMATITE MINE
STORRINGTON TOWNSHIP. FRONTENAC COUNTY.

— ONT. —
SCALE: 50 FT. = ONE INCH.
Surveyed by E. L. Ingalls, A.R.S.M. 1880.
(LOOKING SOUTH)



Photographed by Paul Perreault

from the decomposition of dolomitic portions of the rock carrying iron as carbonate and that this decomposition product had infiltrated into the porous portions of the sandstone filling the interstitial spaces between the grains and collecting in shattered portions of the same. Storrington township.

The specimens collected show every phase of this process from the mere staining of the sandstone yellow or red to the formation of fairly good ore which on fresh fracture shows the little glassy quartz grains of the sandstone cemented together by compact blue black hematitic matter. The final stage of this process is exemplified in some of the specimens collected which consist of really good ore. In these the sandstone grains show only in spots and the mass consists altogether of hematite showing a blue black fracture, compact and earthy to partly crystalline, with slight sparkling of minute crystal facets. The characteristic botryoidal structure is developed in places. Where space has permitted, the mineral has crystallized out into the little vugs in fine platy crystals with bright metallic lustre (specular) and the remaining cavity has been filled in by a white mineral crystallised in platy crystals, with a somewhat radial habit, probably barite. This quality of material would seem to represent the final stage of the consolidation of the ochrey matter collected in the larger interstitial spaces of shattered portions of the rock.

The soakage effect or infiltration of the ferruginous solution through the sandstone is well shown in many parts, some specimens being mottled the process having stopped short along certain lines, leaving white unaffected portions. This result has been evidently due in many cases to the impervious condition of the rock at these places, the sandstone having become consolidated locally to form patches of quartzite.

The development work done at this place consists of an open-cut into the north-west face of the little bluff, a small shaft on the top of the ridge and a diamond drill hole on the south eastern edge of the same. The open-cut is in the sandstone, extending down about 30 feet from the top of the ridge; about 90 feet along its face, and 25 feet in from the edge. The hematitic sandstone shows the features already described and the whole is very much ochre stained. The underlying crystalline limestone, shows at the height of about 30 feet above the road, or half way up from that to the top of the ridge. The little shaft is about 30 feet back from the edge of the open-cut and is about 20 feet deep. At its mouth is a little pile of ore sandstone, showing that rock similar to that in the open cut was encountered in sinking.

The diamond drill hole is said to be about 90 feet deep and to have encountered ore ground at the bottom. In this case the contact plane

of the sandstone and crystalline limestone would be at least 40 feet deeper than on the north-west side of the ridge showing it to dip steeply towards the Dog lake side.

PORTLAND TOWNSHIP.

*Frontenac County.*Portland
township.

Visits were made to a number of places in the vicinity of Fourteen Island lake, Silver and Long lakes, north of Hartington. In the vicinity were found outlying patches of the basal Palaeozoic formations showing the usual features, viz., sandstone of red, and mottled red and white, and white colours with dolomitic portions, the latter often weathering red thus evidencing their ferruginous nature. At some of the points visited the subjacent crystalline limestone was exposed with patches of the basal conglomerate lying on it, often a thin shell only of the same having been left by denudation.

At places there was found the usual association of ochreous and hematitic matter in all stages from the loose ochreous to the solid hematitic form. On the northern end of lot 5, con. X., some small gash veins of hematitic matter were seen in the crystalline limestone, limited in one case by a botryoidal surface. On lot 7, con. X., a pit had been sunk to a depth of about fifteen feet at the contact of the Potsdam and crystalline limestone. The excavation is in a mass of shattered sandstone and conglomerate highly impregnated with ochreous oxide of iron, with occasional pieces of more solid hematite. The face of the limestone is covered with crystals of nailhead spar and appears to go down vertically. It may possibly represent a fault plane which would account for the sudden ending of the sandstone up against the almost vertical face of the limestone. The opening is at the base of a little ridge of red sandstone, which shows included quartz pebbles and false bedding. Apart from this small pit no other work had been done in this vicinity which would enable these relationships to be worked out.

A curious association of compact hematite with brown jaspery matter and large crystals of schorl was seen on lot 4, con. IX., cropping out through the soil. The exposure was not extensive and the cover prevented its relationship to the rocks of the vicinity from being seen. There seems to be some evidence, however, that it was an aggregation of crystals in the crystalline limestone, the hematite portions having probably been derived from the sedimentary rocks previously overlying it.

SOUTH CROSBY TOWNSHIP.

Leeds County.

While passing through the canal locks at Jone's Falls some hematitic specimens were collected from a point a short distance along the road passing eastwards from the hotel. As far as could be judged from the short time available there this appeared to be another occurrence similar to those already described.

S. Crosby
township.

BASTARD TOWNSHIP.

Leeds County.

On lot 23, concession X., a small amount of development work has been done on occurrences of hematitic material. These show at a number of points. The features exhibited are similar to those of already described deposits, the material being at places, of good quality, at others, consisting of sandstone impregnated with ochreous and hematitic matter.

Bastard
township.

A little work has been done at several points, but only on the surface.

OTHER LOCALITIES.

Besides the previously described occurrences, references are to be found in the report of the evidence taken by the Ontario Mineral Commission in 1888-89 to several other places in the district, where in the opinion of the witnesses there occur indications of hematite deposits. Much of this evidence is vague and sometimes contradictory, but on the whole it may be taken as showing the existence at other points of occurrences similar to those personally visited. The localities mentioned are as follows:

Other
localities.

Darling Township.—Mention is made by several of the witnesses examined by the Ontario Mineral Commission of indications of the existence of hematitic matter in the vicinity of White lake. On page 29 we find these occurrences described as follows: "Where exposed the ore appears as gash veins or irregular masses of hematite varying from 6 inches to 12 feet wide, and occurring in a breccia of calc-spar with the same as a lime matrix and the general run of the ore is with

Other
localities.

the formation. In places the hæmatite is the matrix of the calc-spar masses. Openings have been made in several places but very little work has been done on the property."

Dr. Ellis visited this point in 1896 and says that the ore occurs "in the crystalline limestone formation in connection with which no eruptive rocks were visible."

Bathurst Township.—W. J. Morris' evidence. Indications of hæmatite on both sides of Bennett lake at low water.

North Elmsley and North Burgess Townships.—It is reported that indications of hæmatite are found at a number of points in this area. As the edge of the main area of Palæozoic rocks is near by, these are probably also connected with outliers of these rocks on the Archæan.

Some little work said to have been done at Adams lake on hematite indications.

Leeds County.—R. C. Sherret, in his evidence makes mention of an occurrence at Charleston lake, a specimen from which is said to have yielded on analysis 70 per cent of iron.

Addington County.—In the before mentioned report of the Ontario Mineral Commission an occurrence is described as follows: "Hæmatite mixed with a dark coloured shale occurs near the village of Tamworth, at the terminus of the Napanee and Tamworth railway, in the township of Sheffield, county of Addington. Several pits have been sunk at points from 20 to 100 feet apart, from some of which red ore has been taken out: but in every case the pits ran into crystalline limestone which underlies the occurrences of ore, and crops out about 200 feet off. The quality of the ore varies from very lean to rich hæmatite, but there are no signs of the existence of it in large quantities."

According to the evidence of Mr. Leonard Wager (*vide* same report) the above mentioned pits were about ten feet deep when they encountered the crystalline limestone. The ore passed through showed a thickness of about three feet and rested on the limestone. About twenty-five tons of ore were extracted.

APPENDIX A.

MICROSCOPIC EXAMINATION OF SECTIONS OF ROCKS ASSOCIATED WITH THE
IRON ORE DEPOSITS OF THE KINGSTON AND PEMBROKE RAILWAY
DISTRICT BY A. E. HARLOW, M.A., D. SC., PETROGRAPHER
TO THE GEOLOGICAL SURVEY OF CANADA.

Microscopic
Examinations
of rocks.

*No. 1.—Williams or Black Bay Mine.—Lot 22, Concession XI., Town-
ship of Bagot, Renfrew County.*

The hand specimen shows a heavy black, evidently highly ferriferous rock, traversed by bands of much lighter-coloured material, most of which is calcite.

The magnetite which is by far the most abundant mineral represented in the slide, occurs in irregular individuals and areas, including, as well as separated by, smaller individuals and areas of felspar and calcite together with a much smaller proportion of hornblende and chlorite. Pyrite, in considerable amount is very intimately associated with the magnetite. The larger and more continuous areas are composed almost entirely of calcite. It is impossible from the slide to state what the rock has been originally. It may be a highly ferriferous gabbro which has undergone pronounced alteration, or an impure crystalline limestone.

*No. 2.—Bluff Point Mine, Calabogie.—Lot 16, Concession XI., Town-
ship of Bagot, Renfrew County.*

The hand specimen is a medium-textured dark-gray gneissic rock.

(Amphibolite).—Under the microscope it seems to be composed essentially of felspar and hornblende. Felspar is the more abundant and although a considerable portion is striated a large amount is unstriated. Separations of similar rocks from areas in Hastings county have been made by means of Thoulet's solution and show the felspar to be almost altogether labradorite. Good foliation, produced chiefly by the parallel alignment of the hypidiomorphic individuals of hornblende. Sphene is abundant in irregular, usually more or less rounded individuals.

Microscopic
Examinations
of rocks.

Apatite in stout imperfect and rounded crystals is likewise abundant. Pyrite and magnetite are sparingly represented. Calcite is present apparently as a product of decomposition of the felspar.

No. 3.—Bluff Point Mine, Calabogie.—Lot 16, Concession A P., Township of Bagot, Renfrew County.

The hand specimen shows a black glistening metallic rock which is evidently in great part composed of magnetite. Pyrite is also abundant and on planes of shearing greenish decomposition products have been developed. The thin section as might be expected is composed largely of magnetite, together with a much smaller proportion of pyrite. Cracks and interspaces are frequent, which are filled up with calcite, chlorite, sericite and occasionally a little augite.

No. 4.—Campbell Mine—Lot 16, Concession VIII., Township of Bagot, Renfrew County.

The hand specimen shows a rusty-weathering, dark greenish-grey, almost black, basic schistose rock with occasionally narrow bands of pyrrhotite. Under the microscope it is seen to be composed mainly of felspar and hornblende. One side of the slide shows the felspar wholly replaced by scapolite which seems to be an alteration product of the plagioclase. The cleavage cracks and fissures of the scapolite are filled with yellowish-green serpentine or chloritic products derived, mainly at least, from the decomposition of the hornblende. Most of the scapolite, on account of the abundance of these decomposition products polarizes in dull bluish and pale-yellowish tints, but in places where it is fresher it shows an approach to the usual brilliant chromatic polarization. The foliation is marked chiefly by the parallel alignment of the hypidiomorphic hornblende although the other minerals show a marked tendency towards similar parallelism. Most of the felspar is unstriated but from its association it must belong to the basic end of the plagioclase series. Apatite and sphene are both rather abundant. Magnetite is abundant, and pyrite in much smaller quantity. The rock may be called a plagioclase-scapolite-amphibolite.

No. 5.—Christies Lake Mine.—Lot 18, Concession III., South Sherbrooke Township, Lanark County.

The hand specimen shows an interfoliation of a dark-gray almost black, glistening basic schist with a pale-yellowish gray, massive and

more coarsely crystalline rock. The thin section is of the darker coloured portion and shows this to be a very fresh and typical plagioclase-scapolite-diorite. Most of the felspar shows the poly-synthetic twinning lamellæ, although a considerable proportion of the grains are untwinned. It is probably a basic plagioclase. It occurs side by side and embedded in the scapolite both minerals being very fresh, in very irregularly shaped, evidently allotropic grains. The line of contact between the two minerals is very sharp and the only evidence of the derivation of the scapolite from the plagioclase is the fact that what may be still unaltered portions of the latter occur completely surrounded by the former. The hornblende is the compact dark-green variety, and has the usual rather perfect cleavage, in irregular individuals with little or no attempt toward crystalline outline. The pleochroism a light-yellowish green, b dark green, c deep bluish-green is very marked, as is also the absorption $c > b > a$. Deep brown pleochroic biotite occurs for the most part embedded in or intimately associated with the hornblende. Occasionally it occurs as a parallel intergrowth. A deep clove-brown pleochroic sphene, in irregular and large individuals, is also very abundant and frequently occurs completely inclosing an opaque iron ore, probably ilmenite. Apatite is also abundant in irregular or rounded prismatic forms. Pyrite was noticed in occasional individuals completely inclosed in the hornblende.

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No. 6.—Coe Mine.—East half Lot 16, Concession IX., Township of Bagot, Renfrew County.

Amphibolite.—The hand specimen represents the familiar dark-coloured basic, highly schistose bands familiar to Archæan geologists, which so frequently alternate with the light-gray and reddish bands and taken together are so typical of the gneissic rocks usually classified as Laurentian. All the minerals show a very marked parallel arrangement while the schistosity or cleavage is accentuated by bands prevailing rich in biotite. Some of the felspar is striated but a large proportion of it is unstriated while many of the individuals show the sharp extinction usually considered as characteristic of quartz. The thin section shows the rock to be composed chiefly of felspar, hornblende and biotite. Separations have been made by means of Thoulet's heavy solution of several specimens of precisely analogous composition from the country to the west of this area which show clearly, that orthoclase and quartz are entirely absent and that the prevailing light-coloured constituent is a normal labradorite. The hornblende

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of rocks.

is more abundant than the biotite. Apatite is rather plentiful and a little calcite is noticed which has evidently not been derived from the decomposition of any of the other constituents. Occasional areas of a yellowish green serpentineous product occur evidently derived mainly from the decomposition of the hornblende.

No. 7.—Culhane Mine.—North half Lot. 21, Concession VII., Township of Bagot, Renfrew County.

The hand specimen shows a very dark greenish-gray distinctly foliated though somewhat massive basic rock with occasional small patches of light coloured and decidedly more acidic material.

Under the microscope the rock is seen to be a rather typical diorite. Hornblende, which is the most abundant constituent is the compact variety in irregular individuals the interspaces between which are occupied by the allotriomorphic plagioclase. Some of the felspar is striated but a large proportion at least of the unstriated grains are also probably plagioclase. Apatite is present and a little quartz. Very occasional small scales of biotite also occur. Magnetite in small irregular grains and pyrite sometimes altering to limonite are also present. One side of the thin section evidently represents a portion of a decomposed band and is made up of pale greenish chlorite and calcite.

No. 8.—Fournier Mine.—Lot 14, Concession I., Township of South Sherbrooke, Lanark County.

This mine is represented by three thin sections (8, 9, 10) and all are typical of the rock which the late Prof. G. H. Williams called "cabbro-diorite." They present different phases of the rock and a detailed description of each slide will be given.

The hand specimen from which section No. 8 was taken is a very massive, coarsely crystalline basic igneous rock, the principal constituents being easily capable of determination with the naked eye. Under the microscope the rock is seen to be composed of comparatively large individuals or areas of a basic plagioclase, and a pale-green pyroxene. Some of the plagioclase is quite fresh and glossy, but the interior of nearly every individual is very turbid and more or less opaque owing to the development of saussurite. The products of decomposition seem mainly to be kaolin or sericite and calcite. The fresh periphery often shows more or less advanced alteration to scapolite, and a few of the smaller individuals are wholly converted

into this material. The derivation of the scapolite from the plagioclase seems undoubted, and if further corroboration is needed an inspection of the other two slides (9 and 10) would convince the most sceptical of this interesting fact. The augite is very largely in process of alteration into a deep green, strongly trichroic hornblende, and no better or more instructive example of uralitization could be desired. A little sphene and calcite are both represented in the thin section. Some of the individuals of pyroxene show what is usually referred to as 'schillerization products' consisting of dots and dashes of a brownish, nearly opaque material, arranged in parallel lines at right angles with the cleavage. These are more perfectly developed in the unaltered pyroxene, but generally fade away, disappearing altogether in the uralite.

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of rocks.

No. 9.—Fournier Mine.—Lot 14, Concession I., Township of South Sherbrooke, Lanark County.

Is a dark-gray basic rock, much finer-grained than the specimen from which No. 8 was taken, and shows a decided foliation, consisting for the most part in the alternation of lighter and darker bands. It is, however, very similar in composition. The chief constituents are plagioclase, scapolite, pyroxene and hornblende. The derivation of the scapolite from the plagioclase is undoubted. The scapolite constitutes more than half the lighter portion of the slide. Much of the scapolite and plagioclase contain numerous very fine rod-like inclusions which intersect each other at various angles. The uralitization of the pale-green pyroxene is much more complete, and most of the individuals are wholly converted into a dark-green compact, strongly trichroic hornblende; many fragments, however, still show remnants of the unaltered pyroxene, so that the source of the hornblende is undoubted. A little biotite is present, as also apatite, pyrite and sphene. Some of the sphenes contain black opaque cores, probably ilmenite. Calcite is abundant.

No. 10.—Fournier Mine.—Lot 14, Concession I., Township of South Sherbrooke, Lanark County.

No. 10 is taken from the same hand specimen, closer to the ore body. Indeed it forms the rock immediately in contact with the iron ore. The band from which it was cut is of a dark-green colour, brightly glistening on planes of cleavage, and showing, microscopically, only a very small proportion of the felspathic constituents. Under

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of rocks.

the microscope by far the most abundant constituent is a deep green, strongly trichroic hornblende. Its derivation from the pyroxene is likewise undoubted, as one side of the thin section shows cores and areas of the unaltered mineral still surviving. Plagioclase is present and much of it is unstriated. Scapolite is only sparingly represented if at all. Biotite is much more abundant, in larger individuals than in No. 9 and so also is sphene. Nearly all of the opaque mineral present is pyrite, but some is ilmenite. Epidote is also present.

Nos. 11, 12, 13 and 14.—Glendower Mine.—Lot 6, Concession III., Township of Bedford, Frontenac County.

The least altered representative hand specimen from the Glendower mine shows a rather coarse-grained, massive, dark coloured basic rock; a pale yellow mineral is very conspicuous, which on examination proves to be scapolite. Under the microscope the rock, (No. 13) is seen to be what may be called a 'plagioclase-scapolite-gabbro'; a few individuals of the original plagioclase, occurring, for the most part in untwinned grains, still remain, but by far the larger proportion has been altered into what, in thin section, is colourless scapolite but which in the hand specimen is the yellowish mineral mentioned above in the macroscopic description. As mentioned by Adams and Lawson*, the polarization colours are usually very brilliant but sometimes pass through orange and yellow to the dull bluish-gray tints usually characteristic of the felspar so that it is impossible in every instance to distinguish between these two minerals. Occasionally, as noticed by Adams and Lawson, in their examination of the scapolite-diorite from near Arnprior, Ont., traces of polysynthetic lamellæ were observed in which the extinction though much less distinct, than in plagioclase resembled it otherwise very closely. The appearance is very suggestive of the derivation of the scapolite from plagioclase, and if this be the case the twinning structure of the latter is retained after the mineral has apparently been entirely changed to scapolite. Probably, however, in these cases the change may not be complete, and although the mineral has the characteristics of scapolite there may be sufficient plagioclase remaining in twinning position to cause the alternate oblique extinction observed. The index of refraction of the scapolite of the Glendower mine is, however, considerably higher than that of the accompanying plagioclase. The pyroxene has a somewhat faint though decided pleochroism, a yellowish, b greenish, c

*On Some Canadian Rocks Containing Scapolite. Can. Rec. of Science, vol. III, page 19. Oct. 1888.

light-green. It occurs in irregular individuals, penetrated and surrounded by the allotropic scapolite and plagioclase, and shows incipient alteration, chiefly marginal, into a green strongly trichroic hornblende. A deep clove-coloured pleochroic sphene, evidently rich in iron in large irregular fragments, is abundant, as is also apatite in irregular grains and large rounded prismatic forms. A little calcite is also present. Another thin section examined showed the plagioclase entirely converted into scapolite. The hand specimen thus represented might be called a scapolite-gabbro.

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of rocks.

Another specimen examined (No. 12) showed in the hand specimen a basic gneissic rock. Some of the bands are of light-grayish colour, with patches and streaks of pale reddish (scapolite) and greenish (hornblende) mineral. Angular fragments, as well as bands of dark-green amphibolite and diorite occur, while disseminated throughout the whole in grains and patches, is a comparatively large amount of a very pale yellow pyrite.

Under the microscope the lighter portions of the rock are seen to be composed mainly of a basic plagioclase (anorthite?) which has apparently been altered in places into scapolite (wilsonite?). Calcite which may have resulted from the further alteration of the plagioclase, and a much smaller proportion of a green hornblende and still smaller quantity of quartz are also present. A few of the unstriated grains may be orthoclase. The darker or green portions and bands are composed mainly of hornblende together with a much smaller proportion of plagioclase and scapolite.

The scapolite-gabbro above described, may, by an increase in the ferro-magnesian constituent, pass over into a pyroxenite but such a type is unrepresented by any of the hand specimens in the collection examined. One thin section examined, however (No. 11) which might be described as such, had evidently been taken as representative of the ore-body, as is seemed to be composed mainly of magnetite with a very subordinate amount of pyrite. This is surrounded and contains embedded in it the same green pyroxene, already mentioned, undergoing alteration to hornblende and serpentine. Both of these alterations may be seen plainly, in the field. Sometimes the change from pyroxene to serpentine is direct, but at times the hornblende serves as an intermediate stage in the process. Secondary calcite is rather abundant and the belief is entertained that some of it may have been derived from the decomposition of scapolite originally present but the facts presented in this section in support of this view are not incontrovertible. A small amount of dolomite was also noticed.

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Another closely related rock and one which may have been derived from the alteration of a pyroxenite, if such be present in any appreciable quantity at this locality, shows in the hand specimen an almost black glistening basic schistose rock which in thin section under the microscope is seen to be composed almost wholly of green trichroic hornblende. There is little or no felspar present. Magnetite is rather abundant in irregular grains together with a small proportion of pyrite.

The most decomposed portion of the whole rock mass is represented by two thin sections (No. 14). It evidently represents the extreme alteration of a rock which was originally a pyroxenite or an extremely basic amphibolite.

The hand specimen is very fine-grained, compact and only very slightly greasy to the touch. Under the microscope it is seen to be mainly composed of a greenish serpentinous product, noticed in the other sections as resulting from the alteration of pyroxene; small cores of the latter still remain and the mesh-like structure is very similar to the serpentine resulting from the decomposition of olivine. Calcite is abundant, as is also magnetite, the latter mineral filling what appears to be irregular fissures and interspaces in the rock.

*No. 15.—Martel Mine.—Lot 13, Concession X., Township of Bagot,
Renfrew County.*

Macroscopically a dark-green almost black, fine-grained rock with irregular streaks, patches and spots of magnetite and pyrite disseminated throughout.

Examination of the thin section shows the rock to be a typical diorite, composed chiefly of hornblende and plagioclase. Some of the plagioclases exhibit the twinning striae, but the larger proportion of the felspar consists of untwinned grains and most of this, at least from its association is probably plagioclase. As a rule it is quite fresh, but some of it decomposed into a saussurite aggregate of which calcite is the prominent constituent. The hornblende is the compact green pleochroic variety, some of it altered into a green chlorite. Apatite in comparatively large prisms is abundant as is also sphene. Most of the opaque mineral is magnetite although pyrite is also rather plentiful.

No. 16.—Ritchie Mine.—Lot 16, Concession VII., Township of S. Sherbrooke, Lanark County.

Macroscopically a pink-coloured gneissic granitoid rock. The foliation is chiefly marked by narrow bands of dark-greenish material. Under the microscope it is seen to be a scapolite-augite-syenite-gneiss. The minerals present are orthoclase, microperthite, plagioclase, scapolite and pyroxene, with small quantities of sphene, apatite, magnetite and occasional scales of biotite. The pyroxene is in irregular grains, is of a deep green colour, and shows a faint though decided pleochroism. In a few individuals incipient alteration to a deep-green hornblende was noticed. The scapolite may be plainly distinguished from the felspar by its brilliant chromatic polarization, high index of refraction and the presence of the cleavage cracks filled with a yellowish decomposition product. The sphene is in large rounded lumps and together with the rounded prisms of apatite is for the most part intimately associated with the pyroxene. Quartz seems to be entirely absent.

No. 16a.—Ritchie Mine.—Lot 16, Concession VII., Township of Sherbrooke, Lanark County.

The hand specimen shows a dark-green, almost black, somewhat coarse massive crystalline rock. Under the microscope it is seen to be a diorite. The plagioclase, which is in very small amount, is largely altered to calcite, together with a little epidote and chlorite. The very abundant hornblende is of the usual compact dark-green variety. Magnetite is present, mostly associated with the decomposed plagioclase. Apatite is present in occasional large rounded individuals. Calcite may frequently be noticed embedded in the hornblende in sharp individuals.

No. 16b and 16c.—Ritchie Mine.—Lot 16, Concession VII., Township of S. Sherbrooke, Lanark County.

Are taken from the same hand specimen, which shows a pale flesh-red massive granitoid rock in contact with a dark-gray more basic schistose rock. The line of contact is quite sharp, and the acid portion appears to be the newer. Under the microscope the red granitoid rock is seen to be a syenite composed of orthoclase, microperthite, oligoclase, albite, with much smaller quantities of hornblende, biotite, sphene, and magnetite. The coloured constituents are in small irregu ar

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more or less separated individuals, and are barely sufficient to characterize the rock. The basic schist is a very typical and fresh scapolite gabbro. The green pyroxene has a faint though quite distinct pleochroism, yellowish and greenish. It shows only incipient alteration to deep-green hornblende. Sphene is present in irregular individuals. In spite of the evidence of intrusion of the syenite through the scapolite gabbro, and this comparatively sharp line of contact, it is possible that both may represent differentiated portions of the same magma. One strong evidence of this fact is the presence in both of the same green pleochroic pyroxene.

No. 16d.—Ritchie Mine.—Lot 16, Concession VII., Township of Sherbrooke, Lanark County.

The hand specimen shows a flesh-red well foliated, evidently highly felspathic, granitic rock. The foliation is marked by the occurrence of very narrow disconnected though closely parallel bands of a dark-green colour.

The thin section shows the rock to be an augite-syenite-gneiss. It is composed of orthoclase, microperthite, oligoclase and albite, with much smaller quantities of augite, biotite, hornblende, sphene, apatite and iron ore, part of which at least is ilmenite. Some of the individuals of augite are quite fresh but others are partially or completely altered to a dark-green compact strongly pleochroic hornblende.

Nos. 17 and 18.—Robertsville Mine.—Lot 3, Concession IX., Township of Palmerston, Frontenac County.

Specimens from which sections 17 and 18 were made vary from gray (17) to dark greenish-gray (18) according to the abundance of the ferromagnesian constituents. Small veins or dykes of a deep flesh-red mineral (cryptoperthite) are associated with a pale greenish-yellow mineral (epidote). Under the microscope in the section examined (No. 17) the rock seems to be a decomposed diorite composed essentially of plagioclase and hornblende. The plagioclase is sometimes rather fresh, but generally it is more or less turbid due to dust like inclusions in addition to various products of decomposition. The hornblende has a tendency towards the actinolitic habit and a considerable proportion is altered to chlorite. Apatite and sphene are both present in considerable quantity. Pyrite is rather abundant and several individuals of magnetite were noticed. One side of the slide shows a portion of

one of the reddish dykes or veins already mentioned and is made up of cryptoperthite with a smaller amount of plagioclase with yellowish epidote filling up the irregular cracks and interspaces. Microscopic
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of rocks.

*No. 19.—Wilbur Mine.—Lot 4, Concession XII., Lavant Township,
Lanark County.*

The hand specimen shows a dark reddish gneissic rock. Microscopically the rock is seen to be composed of orthoclase, plagioclase, quartz and biotite with smaller amounts of epidote, sphene, apatite and allanite. It would thus be classified as a biotite-granite-gneiss, or granitite-gneiss.

*Nos. 20 and 21.—Yuill Mine.—East half Lot 25, Concession V.,
Township of Darling, Lanark County.*

The hand specimens which represent the ore show a magnetite with a considerable proportion of rocky matter. Section No. 20 is composed almost wholly of magnetite containing numerous irregular fissures and interspaces which are filled with feldspar, chlorite and calcite. Section 21 is also largely composed of magnetite, separated by tongues or bands of fine-grained diorite. The magnetite is also full of irregular interspaces which are filled up with hornblende and plagioclase.

GEOLOGICAL PA

ANALYSES OF IRON ORES

References, Reports of Geological Survey Department.	Name of Mine.	Name of Township.	Range and Lat.	Analyst.
66-69, p. 257	Chaffey	South Crosby	VI., 26, 27	
"	"	"	VI., 26, 27	Hayes (Boston)
71-72, p. 123	"	"	VI., 26, 27	"
1895, p. 19 R	Vankes or Matthews	North Crosby	VI., 1	Geological Survey
71-72, p. 123	"	"	VI., 1	"
66-69, p. 258	Allan	"	IV., 27	"
88-89, p. 22 R	"	"	IV., 12	"
71-72, p. 123	Foley	Bathurst	II., 9, 10	Geological Survey
1895, p. 19 R	Bawden	"	VIII., 11	"
"	Geo. Farrells	"	I., 5	"
73-74, p. 210	Christie's Lake	South Sherbrooke	III., 18, 19, 20	"
"	"	"	III., 19, 20	"
87-88, p. 24 T	"	"	III., 19	"
71-72, p. 123	Bygrove	"	I., 3	"
1895, p. 19 R	"	"	I., 3	"
71-72, p. 123	Fournier	"	I., 14	"
1895, p. 19 R	"	"	I., 14	"
"	Ritchie	"	VII., 16	"
"	Morrow	"	VIII., 13	"
"	Buchanan	"	IX., 9	"
74-75, p. 116	Silver Lake	"	IV., 14, 15, 16	"
80-82, p. 8 H	"	Bagot	VI., 13	"
"	"	"	XII., 5	"
"	"	"	XII., E. 10	"
"	"	"	VII., 12	"
1895, p. 19 M	Martel or Wilson	"	X., 13	"
1895, p. 19 R	Culhans	"	VII., N. 21	"
"	"	"	VII., N. 21	"
"	Co.	"	IX., E. 16	"
"	Lerond	"	IX., 23	"
A	Bluff Point	"	XI., 16 (See foot note A).	"
1895, p. 19 R	"	"	XI., 16	Geological Survey
"	"	"	XI., 16	"
"	Bailey property	"	XI., 16	"
"	Williams or Black Bay	"	XI., 18	"
82-84, p. 10 L	Glendower	Bedford	XI., 22	"
"	"	"	III., 6	M. E. Reed
"	"	"	III., 6	"
1895, p. 19 R	"	"	III., 6	Geological Survey
87-88, p. 24 T	Crow Lake	"	III., 6	"
73-74, p. 211	Eagle Lake	"	IV., 28	"
79-80, p. 16 H	"	Fitzroy	X., E. 6	Geological Survey
"	"	"	X., E. 6	"
80-82, p. 8 H	"	Olden	XI., 17	"
1895, p. 19 R	Robertsville	Palmerston	IX., 3	"
"	Mary	"	IX., 4	"
"	Mississippi Show	"	X., 7	"
"	Near Lavant Station, (T. B. Caldwell)	"	XI., 27, 28	"
"	Smith	Portland	XIII., W. 5	"
"	Ynull	Darling	VIII., E. 25	"
"	Wilbur	Lavant	XII., 4	"
1893, p. 678	McNab	McNab	C., 6	"
66-69, p. 260	"	"	D., 6	"
71-72, p. 123	Dalhousie or Playfair	Dalhousie	IV., 1	"
73-74, p. 225	"	"	IV., 1	"
"	"	Elmsley	VI., 30	"
82-84, p. 17 MM	Sharbot Lake	"	"	"
1886, p. 18 T	Chaffey's Lock, 5, (near)	South Crosby	IX., 19	"
88-89, p. 21 R	Carleton Place (near)	Beckwith	XI., 14	"
"	White Lake (South shore)	Darling	XI., 24	"
90-91, p. 39 R	"	Bastard	"	"
1895, p. 19 R	Birch Lake	Bedford	VII., 2	"
"	Near Robertsville	Palmerston	IX., 1	"
"	Roger's Farm	Bathurst	IV., 2	"
"	Bain's	"	X., 23	"
"	Dog Lake	Storrington	X., 20	"
"	Babcock	Portland	IX., 4	"

A.—From an average sample of a large pile of ore from the mine lying at the works of the Canada Iron Furnace Co., Radnor Forges, of the Geological Survey Department, giving year and page.

* Gr. separated matter = 74.2%. † Finely disseminated apatite. ‡ Small apatite crystals, visible to the eye.

AL SURVEY OF CANADA.

PART I. VOL. XII.

APPENDIX B.

IRON ORES.—KINGSTON AND PEMBROKE RAILWAY DISTRICT.

Analyst.	Metallic Iron.	FeO ² .	Fe ² O ³ .	Phosphorus (Phosphoric Acid).	Insoluble (Should be Ascertained).	Titanic Acid.	Lim. (Carb. of Lime).	Magnesia (Carb. of Magnesia).	Alumina.	Silica.	Insoluble Matter.	Water.	CO ² .
MAGNETITES.													
(Boston)	50.23		60.77	0.085	1.520	0.80		4.50	5.65	7.10		2.450	
	51.76				1.400	16.45		4.42		5.04			
al Survey	52.91			traces.		5.70							
	56.71			0.012		found.							
	52.00			traces.		traces.					41.40		
	64.00			0.007	large amt.	12.32							
al Survey	58.77		80.14	0.007	0.120	1.03	0.82	0.84	1.33		5.25	traces.	
	58.60					absent.					7.28		
	62.02			traces.		2.68							
	59.81			0.010							6.67		
	63.00		87.00								9.12		
	65.62		90.61	(0.05) 0.011	undeterm.	2.83					12.19		
	60.81					absent.							
	59.55					"							
	62.05			0.007							6.50		
	59.59					absent.							
	60.89			0.002							10.01		
	67.64			0.008							2.72		
	67.69			0.012							3.10		
	62.12			0.008							10.25		
	64.15		85.59		1.750						5.75		
	45.87					traces.					28.56		
						absent.							
						"							
	59.95		(Fe ² O ³ 57.35 Fe O 25.46)	0.070 (0.163)	0.207						14.50		
	49.78			0.030							9.32		
	64.43			0.012							2.24		
	58.18			0.004							7.31		
note A).	48.78			0.030							5.80		
al Survey	59.50		82.18	(0.54) 0.170	0.51 0.160		0.01		4.80	9.10		0.51	
	62.43			0.030							4.55		
	51.38			0.004							7.90		
	63.93		(Fe ² O ³ 61.14 Fe O 27.20)	absent.	0.100	absent.					4.85		
	66.60			0.008							2.60		
ed.	51.89			0.016							15.95		
	61.87			0.015	traces.		0.68	2.01		9.78		0.50	
	62.34			0.010	0.300		0.64	0.98		10.67		0.51	
l Survey	63.80			0.011	0.120		0.09	4.01		8.30		0.47	
	61.35			0.004							11.11		
	44.57			0.006							16.25		
	62.98					absent.							
man.	62.52		(Fe ² O ³ 59.39 Fe O 25.93)	traces.	0.070	3.23	0.33	0.82	0.67		8.38	traces.	
l Survey	64.75		(Fe ² O ³ 57.87 Fe O 31.15)		5.290					2.83		Hygros. 0.046	
	22.84		(Fe ² O ³ 19.84 Fe O 11.51)			present.					59.75	0.207	
	70.24		(Fe ² O ³ 68.14 Fe O 28.97)			absent.					1.36	Hygros. 0.059	
	56.68			0.046							9.53		
	37.78			0.040							43.61		
	57.62			0.088							13.72		
	52.39			0.010							16.72		
	46.25			undeterm.		4.40					10.35		
	62.42			0.010							9.11		
	60.32			traces.							7.97		
HEMATITES.													
	58.80	84.10					(8.80)			4.00		3.100	
	59.09	84.42		0.050	0.665		(5.40)	(1.05) 0.50			7.16		
	57.60	82.25		0.026			Trace.				16.05	0.660	
	60.34	86.20									10.30		
	62.36	89.10		(0.02)	0.070	absent.							
	50.13												
	28.14												
	57.17	81.67	(0.245) 0.107	0.011	absent.	1.48	0.046	0.913	13.85		0.998	0.08	0.651
	64.82	92.60	(0.538) 0.235	0.004									
	65.98												
	64.97			0.010							6.61		
	51.63			0.06							9.06		
	51.89			0.005							21.24		
	47.84			0.016							22.82		
	51.12			0.300							19.85		
	52.26			0.004							24.57		

Forges, Quebec; made by the company's chemist, and kindly furnished by Geo. E. Drummond, Esq., Managing Director. The other references are to the Reports.